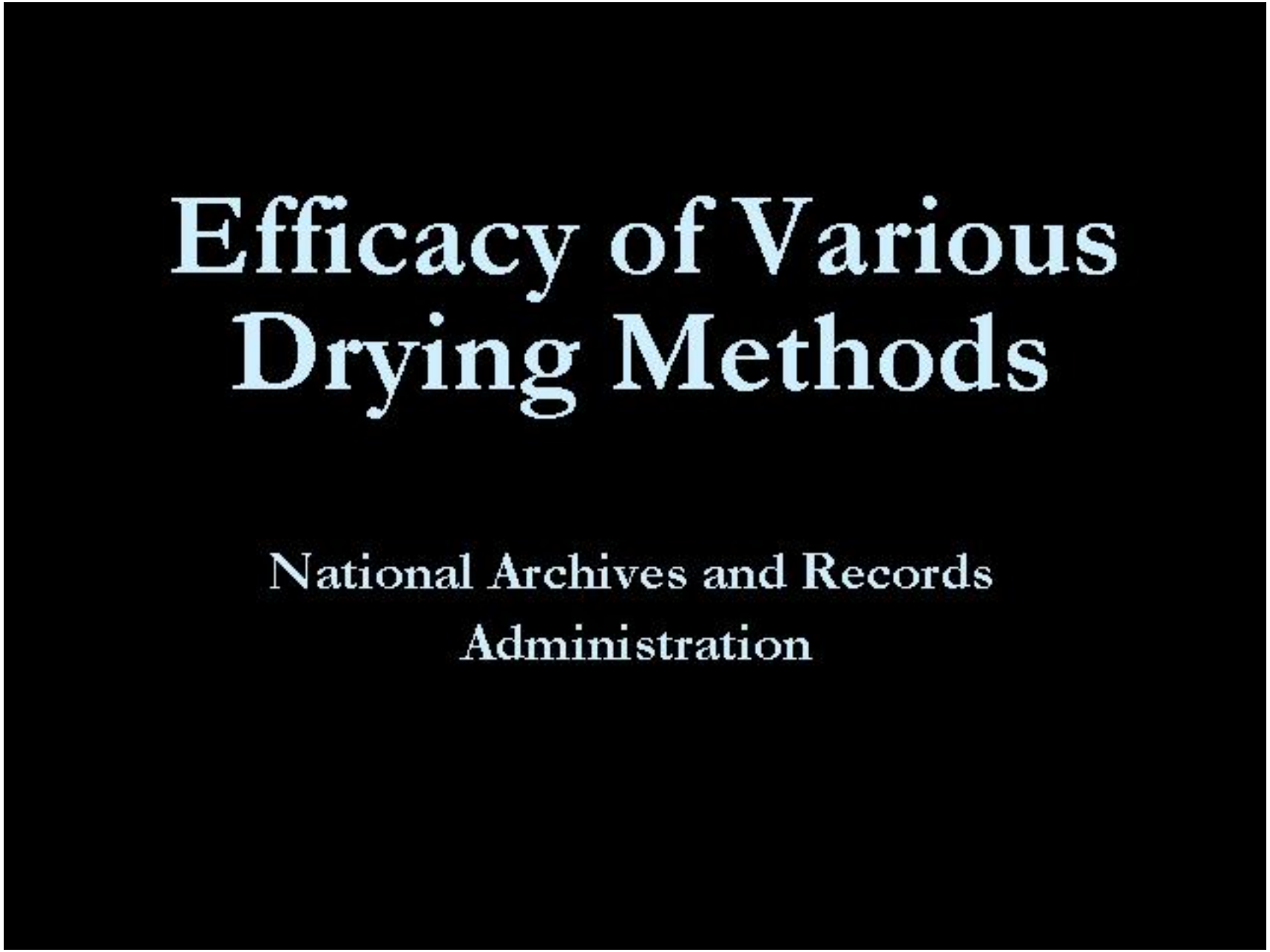

by Kathy Ludwig
Senior Paper Conservator, NARA

The Conservation Lab at the National Archives continually augments and re-evaluates its disaster and recovery plan with

experience gained from previous emergency events. Due both to the small scale of the holdings affected, or the imperative of security and privacy requirements, very little has been sent off-site for drying--the exception being the case study just described by Susan. Thus our opportunity to experience and evaluate the results from various vendor drying services has been limited.

The conservation staff consults and strives to keep current with the body of authoritative resources that exist. Most recovery guides convey the bottom line, as they should, and recommend one drying method over another for a particular material. As most of you know, archival holdings represent a wide variety of formats and media that may often be contained in one box. If the emergency affects a moderate to large quantity of holdings, sorting and culling out disparate materials from wet records may not be practical or even possible.

The conservation lab decided to carry out a small drying project to observe the results of these recommendations. We set out to compare the effects of four different drying approaches; air-drying, desiccant drying, vacuum thermal drying and freeze drying, all on like materials.
The following presentation will share with you how we carried out this small study; some observations that were made; and what we learned along the way.

The study was performed with expendable materials donated by various NARA custodial units. The donations did not represent the vast universe of media and supports found within archives, but did provide enough samples to create 7 duplicate sets of 2 cubic feet of paper records. The focus was on of paper records, therefore magnetic, electronic, and film records were not included.

Items included bound record books, ledgers, various reprographic copies and architectural reproductions, papers with pressure sensitive tapes, Post-it notes, soluble inks, various metal fasteners and rubber bands, encapsulated items, items placed in polyester sleeves, coated papers, and photographs.

Acknowledgements

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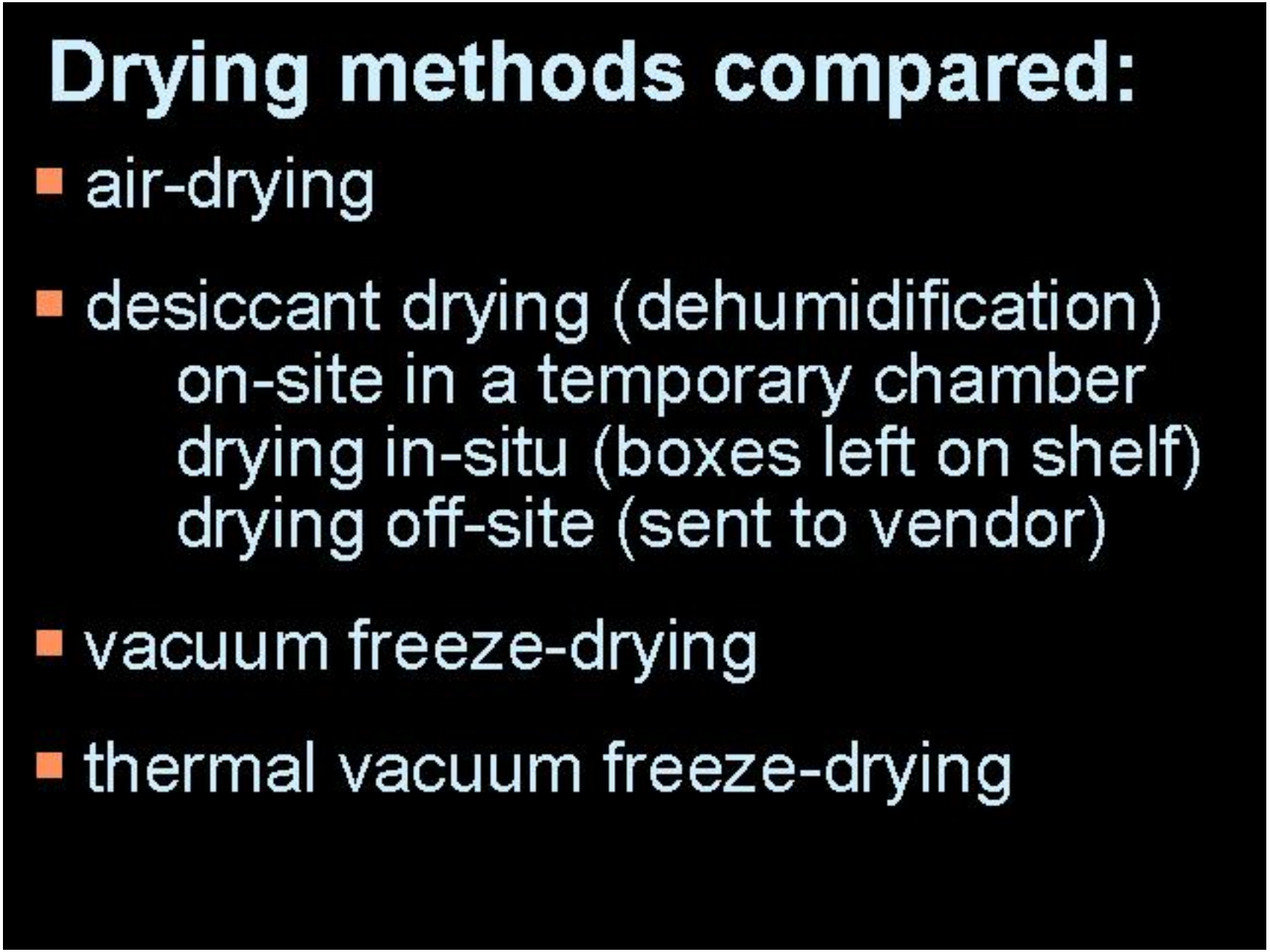


Air Drying-- involves drying records in a workspace at room temperature. Typically materials are spread out on, or interleaved with, absorbent papers. In some instances materials may be dried under restraint in a stack of weighted

blotters.
Air drying is a method that we've had a lot of experience with. It gives us the security and privacy controls that are often required for our holdings, allows us to separate out materials that need special handling, such as photos, coated paper, parchment, magnetic media, etc., and provides direct monitoring of the original order and intellectual control of materials.

Desiccant Drying --
May also be thought of as dehumidification drying.
Materials are dried by pumping cycles of moist air out of a chamber and introducing dried (dehumidified) air at a very low RH's, often below 20%
AirTemperatures vary but usually are in the range of 80-100 F.
This method is often cited in the literature as having excellent results for damp collections and allows one to have access to the materials during the drying process, if that is required. It can be performed on-site with equipment rented from a vendor, employing in-house staff or professionals from the drying service, or items can be sent directly to the vendor for services. Drying is complete within several days, depending on wetness.

Since a chamber was already up and running at the WNRC, we decided to compare the results of desiccant drying done by our staff to those that were done by a vendor off-site.

vacuum freeze-drying
is generally recommended for wet or damp materials which have been previously frozen. It dries the materials under a high vacuum with temperatures below freezing and applies cycles of controlled heat. This process causes frozen water to sublimate to a vapor without passing through the liquid stage. The items remain frozen throughout the drying process. It has the advantage of minimizing the feathering and bleeding of soluble media, allows coated materials to dry without blocking, and results in minimal distortion to the records. The process can be performed on-site, or items can be sent to a drying facility. Drying time depends on the wetness of the materials, but can usually be accomplished less than two weeks.

The fourth method we set out to include was that of vacuum thermal drying.
Vacuum thermal drying is recommend for wet or damp materials. The materials are dried in a chamber, under a vacuum with cycles of warm to hot air. It's generally recommended for uncoated papers and is often cited as a cost effective option for archival materials of low intrinsic value. This procedure is noted to distort paper due to the freeze and thaw cycles during drying process and causes coated records to block, and exacerbates the feathering and bleeding of soluble inks. The drying time is usually less than vacuum free-drying, but again depends on initial wetness.

We in fact, did not investigate this process, despite the fact that this was the service I thought we were purchasing. This was possibly due to miscommunication of the semantics on both sides and certainly points our the importance of using

clear specifications and accurate terminology by both parties. I sent the materials for vacuum freeze-drying, not thermal vacuum freeze-drying and only became aware of the misunderstanding when the materials were returned and did not display the characteristic effects as described in the literature.

Regardless, the results from thermal vacuum freeze-drying provided another useful option for comparison. It's similar to vacuum freeze drying, in using reduced pressure along with controlled heat to vaporize the water, but also employs a patented procedure to compress the materials into shape. It's more expensive, per cubic foot, than vacuum freeze-drying, thus it was useful to see what the added expense would buy for archival holdings.

We hope to examine the effects of vacuum thermal drying in the near future, but I do not have the results to share with you today.

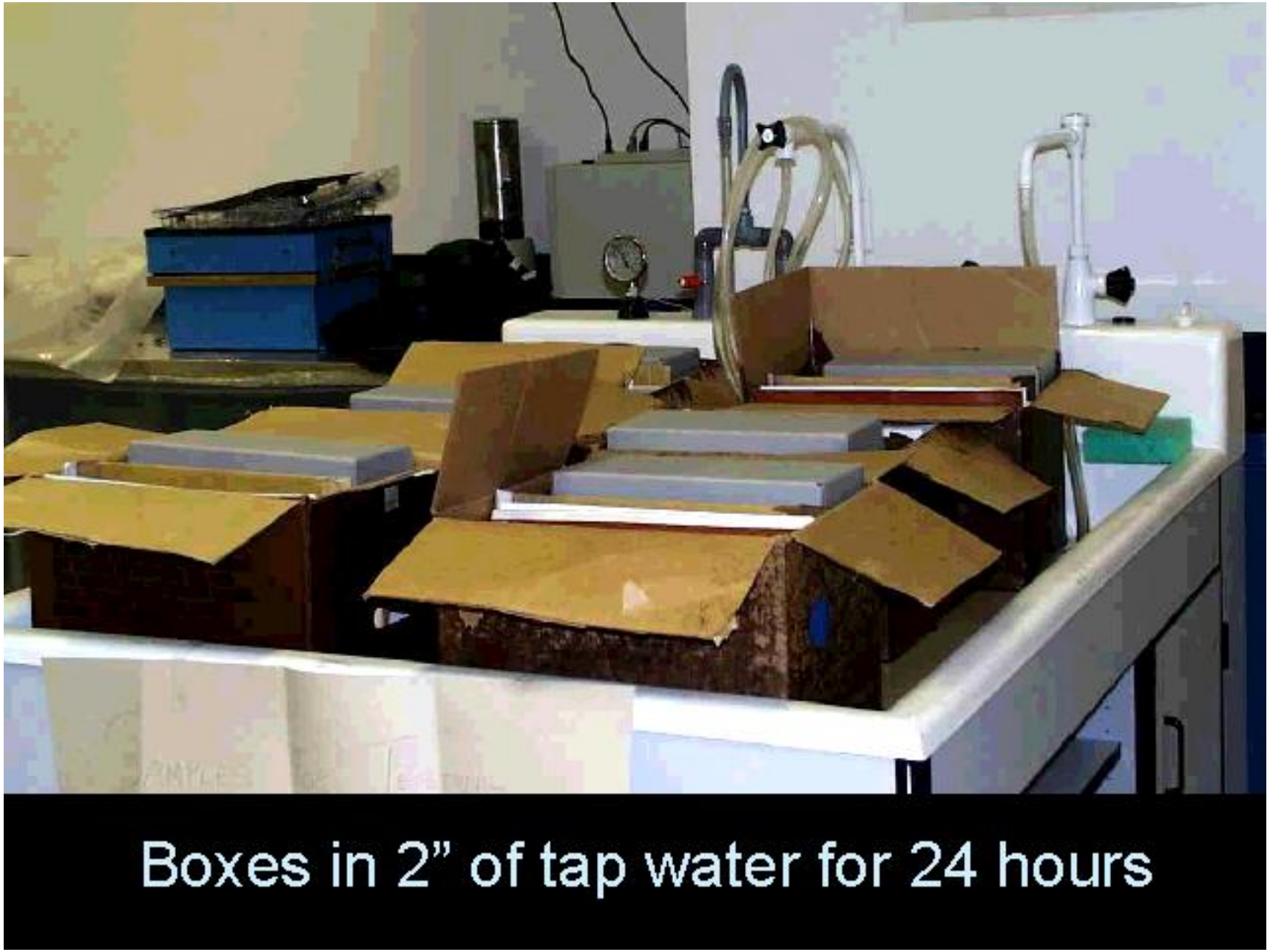
I would also like to add that I will not be identifying the vendors used in this study. This is being done to allow total freedom in assessing the results. The vendors were aware of our project and whether this had any effect on how the materials were handled cannot be determined.
A number of variables existed, which could have contributed to the final observable results on the records. For example, all compared records were not identical in structure and media, differential wetting may have occurred at the outset and the handling and environmental conditions to which the boxes were exposed during transport to the drying facility may have varied widely.

7 sets of boxes (2 each) were carefully packed with expendable materials. Special care was taken to place all items in the same order. 6 sets were wetted and dried with the 7th set left untreated to serve as a control.

NARA’s photo conservator, Brenda Bernier, assisted with the preparation and evaluation of the various drying effects on photo materials.

Included in each box of samples was a selection of silver gelatin photographic prints on fiber-based paper, although some were black and white prints on resin-coated paper. There were also a few samples of color slides, as well as color or chromogenic prints on resin-coated paper.

The same boxes that contained the expendable materials were used in the study.



Boxes in 2” of tap water for 24 hours

All of the 12 boxes were immersed in 2” of water.
Half of the boxes had 8 liters of tap water poured over their tops to approximate an overhead water event. This was done to achieve two levels of wetness.

In preparation for freezing and shipping, the 12 boxes were then wrapped in 2 sheets of 4-ml polyethylene sheeting, one at a time, and all seams heavily sealed with packing tape.

This was done based on recommendations from the vendors to send the records frozen, overnight express.

The wet and wrapped boxes were placed in 2 chest freezers for 4 days. A data logger was placed in the freezer to determine its temperature.

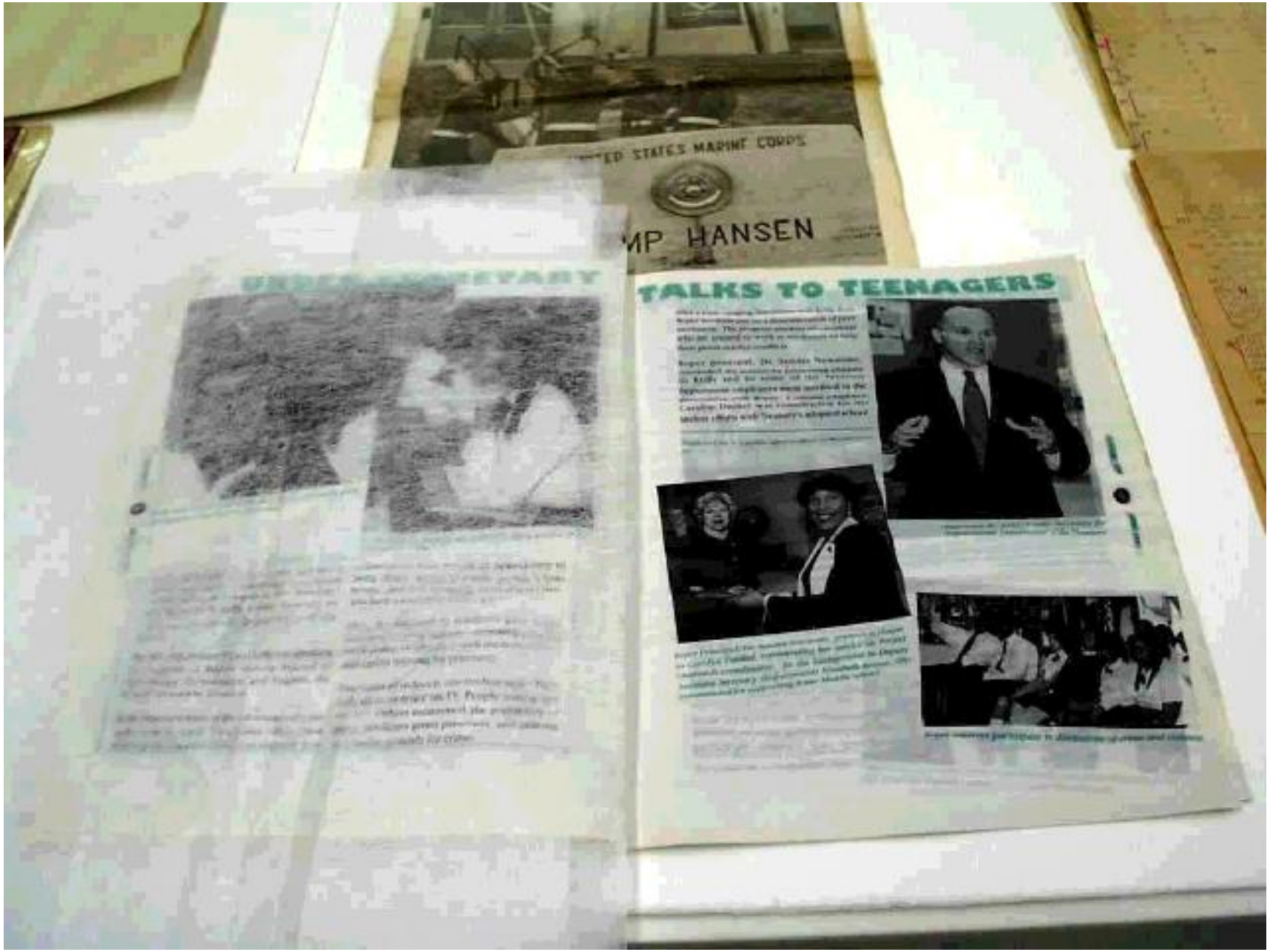
They were then wrapped in Kraft paper and shipped overnight via FedEx..
Recommendations were made that the boxes not be sent on a Friday so that they would not arrive over the weekend.
All boxes were mailed on a Tuesday around noon and were delivered by 2 p.m. the following day.

I will now briefly illustrate the air drying procedure used to dry 2 boxes of records.

After 24 hours of thawing the plastic sheeting was removed from the boxes and the records were removed for drying.

Items were laid onto work surfaces covered with blotter paper. Attention was paid to maintaining the original order of the files and contents within.

Pages of volumes were periodically turned.
Groupings of papers were turned to expose wet surfaces thought the process.



Spundbond polyester sheeting was cut and interleaved between coated papers. For comparison, half of this booklet was left to dry without interleaving.

Shrink wrap does not provide a moisture barrier, as you can see.

Shrink wrapped volumes would normally have their film removed to allow drying.

For experimental sake, I left the volume wrapped to see if it would successfully dry without removal, and if so, how long would it take?

The encapsulated items were sealed in 4-mil polyester film using the ultrasonic welder. To my surprise some encapsulations displayed areas of wetness. This migration of moisture may have resulted from a flaw in the seal, but none could be observed.

detail

These three sheets of paper were placed into polyester L-sleeves, and placed as a grouping within the box, yet only one, the sheet made of newsprint got wet, totally saturated. This sponge like property of the groundwood containing paper was observed in numerous situations throughout the holdings within the box. Often newsprint papers would be totally saturated while adjacent

sheets would only be wet up to the 2” water line.

The photographs were dried in blotter packs, as this is the optimum method of recovery. In a blotter pack, the photographs are placed face down between layers of smooth polyester webbing, then blotter paper.

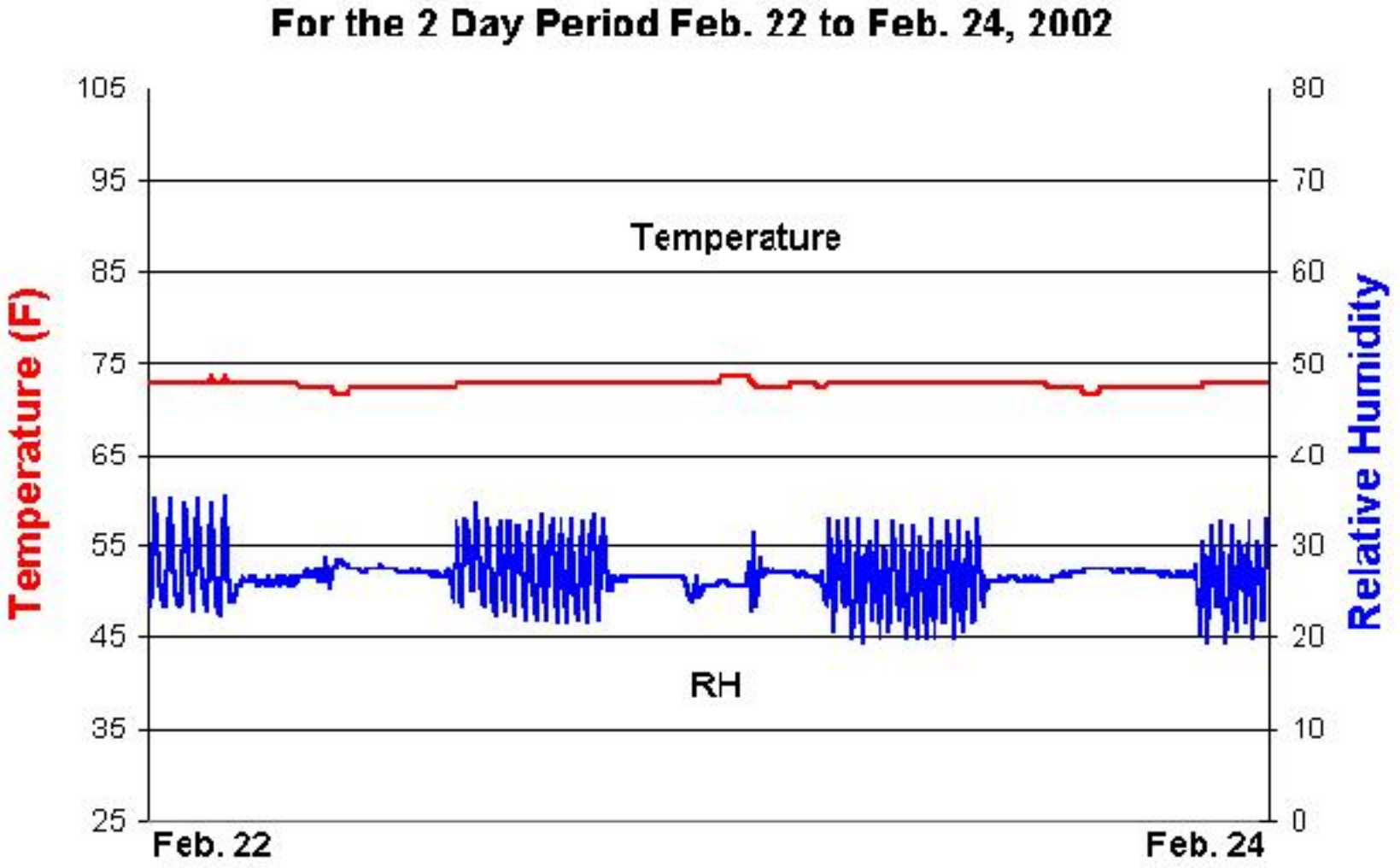
The polyester webbing is essential for preventing the photographs from sticking to the blotter.

Multiple layers of sandwiched photographs were placed on top of each other, saving valuable work space.

The entire pack was then covered with plexiglass for even pressure. Weights were added to minimize distortion.

This is essentially a one-step process because the prints can be safely dried, usually resulting in relatively flat prints with no

discernable surface change.



Drying was successfully completed in 2 days.

T--just above 70

RH -- between 20 and lox 30 %


Desiccant
drying on-site

I’d like to thank Alan Kramer for sharing a section of the temporary on-site desiccant drying chamber at the WNRC. The experimental records were arranged in the same manner that has been used in the chamber.

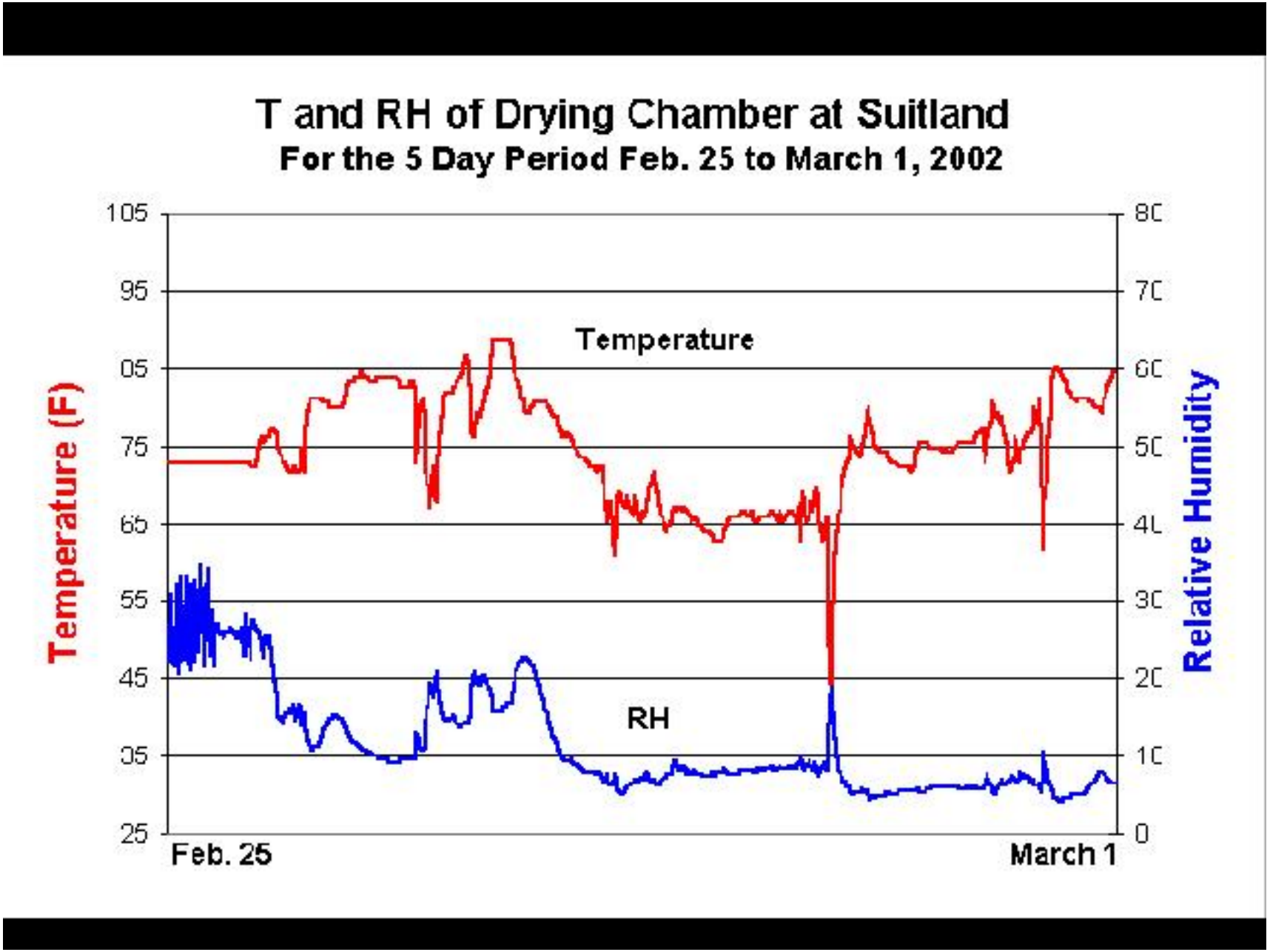
Photos would customarily be dried in the same blotter pack fashion as Brenda illustrated with air drying. But for experimental sake, the photos were desiccant air-dried horizontally, in a single layer, emulsion side up on shelves with the PVC poles removed. This was done to see if there would be exacerbated cockling due to the unrestrained drying in warm dry air.

PVC poles used to support ledger books.

Records set out to desiccant-dry after thawing

Note the use of corrugated boards and blotter paper as supports, as you saw pointed out in Susan’s presentation.

Same records after 48 hours of desiccant drying



Range average of T 65-85 degrees F

RH 5-20 %

All materials thoroughly dried in 5 days


Desiccant
drying in-situ

In-situ drying has been recommended in the literature for damp materials.

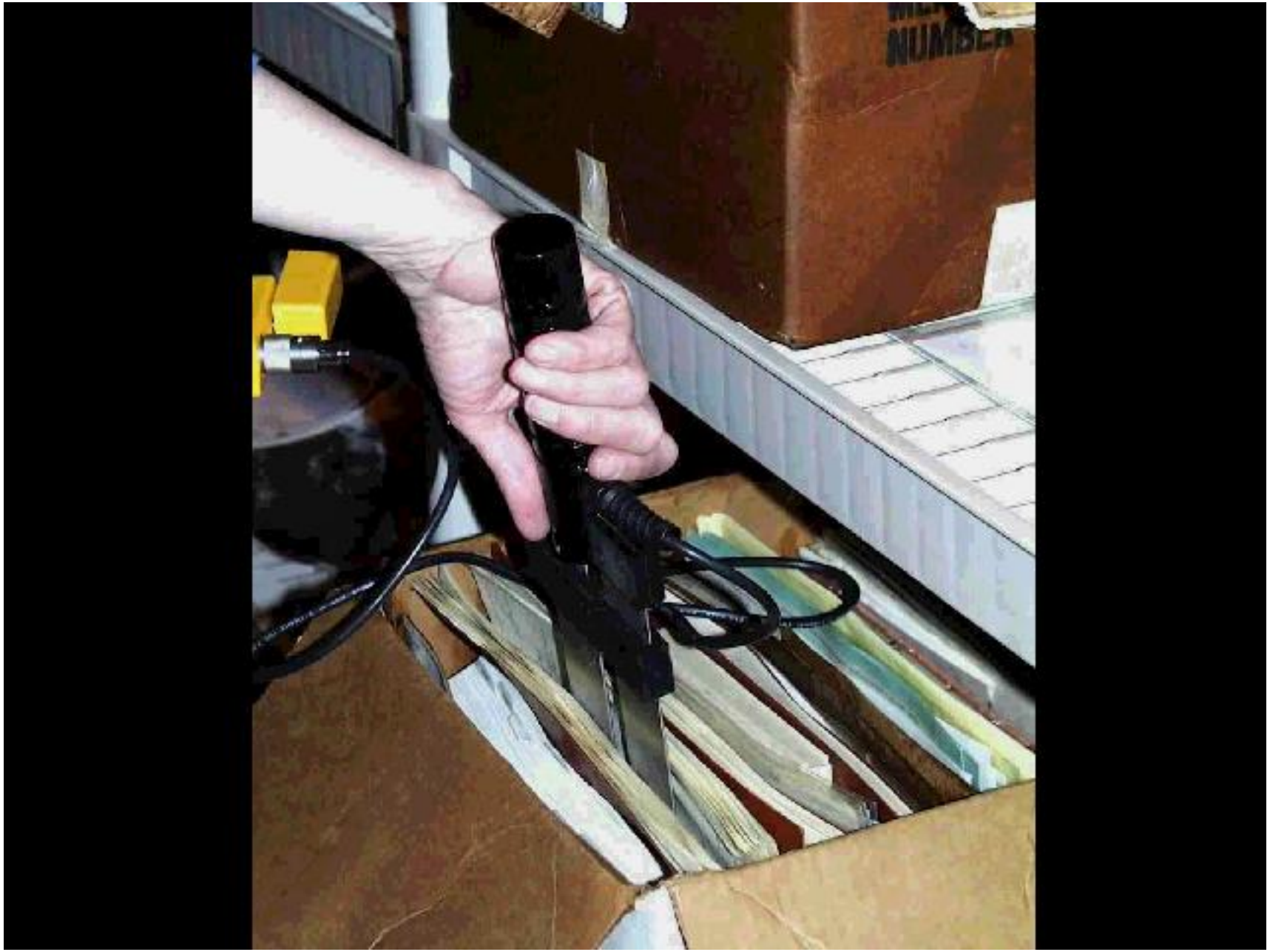
These materials were beyond damp. But I couldn’t pass up the opportunity to see if the dry air would allow the boxes to

eventually dry, without the adverse affects of mold. A data logger was placed next to the boxes to record environmental conditions, and % moisture content data was recorded daily to track the drying progression.

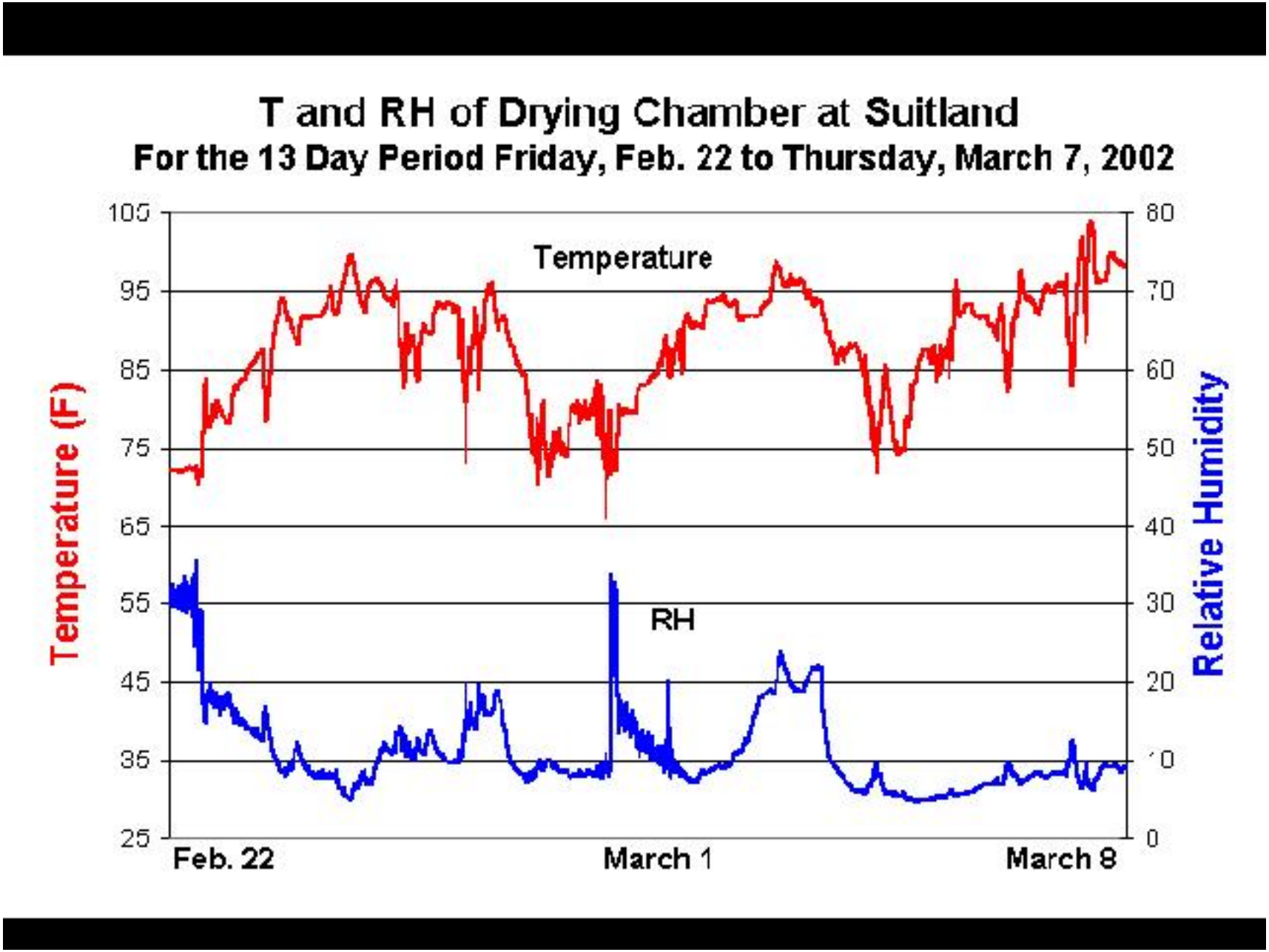
Janet Kennelly, archivist at the WNRC, kindly agreed to take the measurements for me and record the data. She is using a Delmhorst P2000 moisture meter.

Delmhorst p2000 paper moisture meter
70 --90 F
measures the relationship between moisture content and electrical resistance

4.3-18% mc



Note: the 12” probe, how it allows easy measurement down to the floor of the box. This is important as this is the area that is most often the wettest.



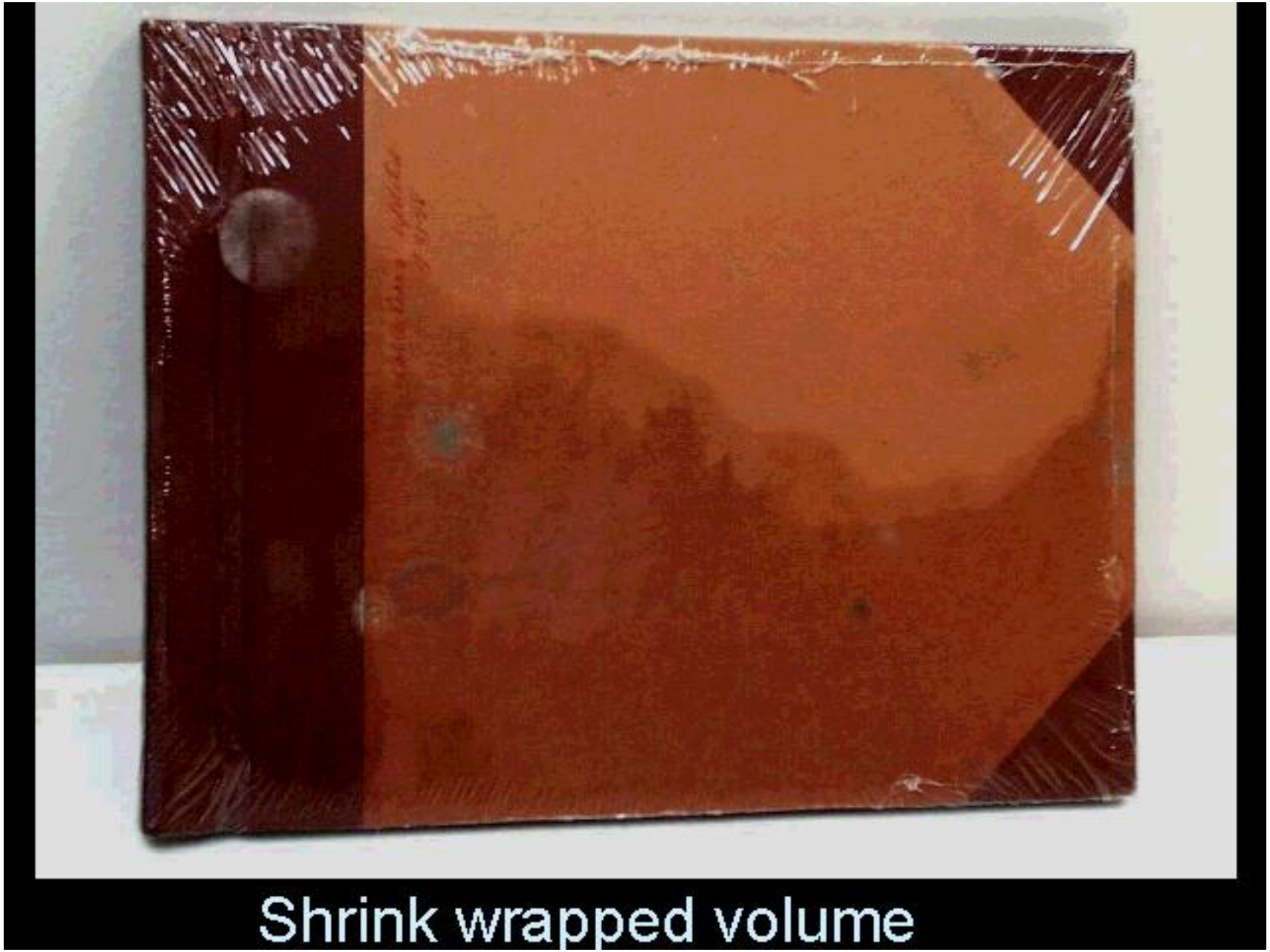
The in-situ drying trial had to end on the12th day as the WNRC drying project ended. The rented drying equipment needed to be returned.

The boxes never dried. A core area of the wet box started out at 18.2 % moisture content and remained at that percentage with the

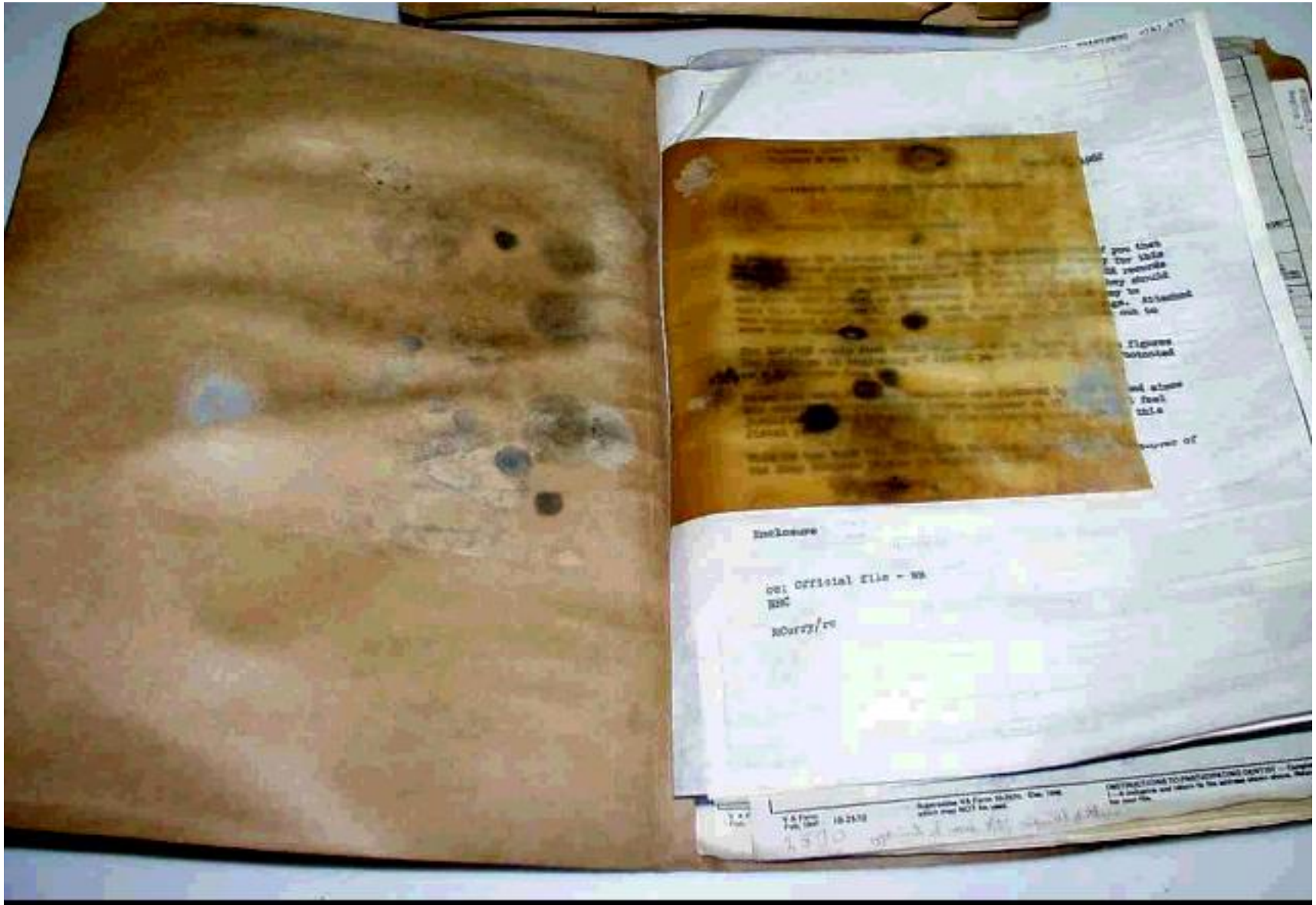
last reading. The sides and ends were beginning to dry.

The less wet box went from 16.0 to 15.3%. Over the 12 day period.

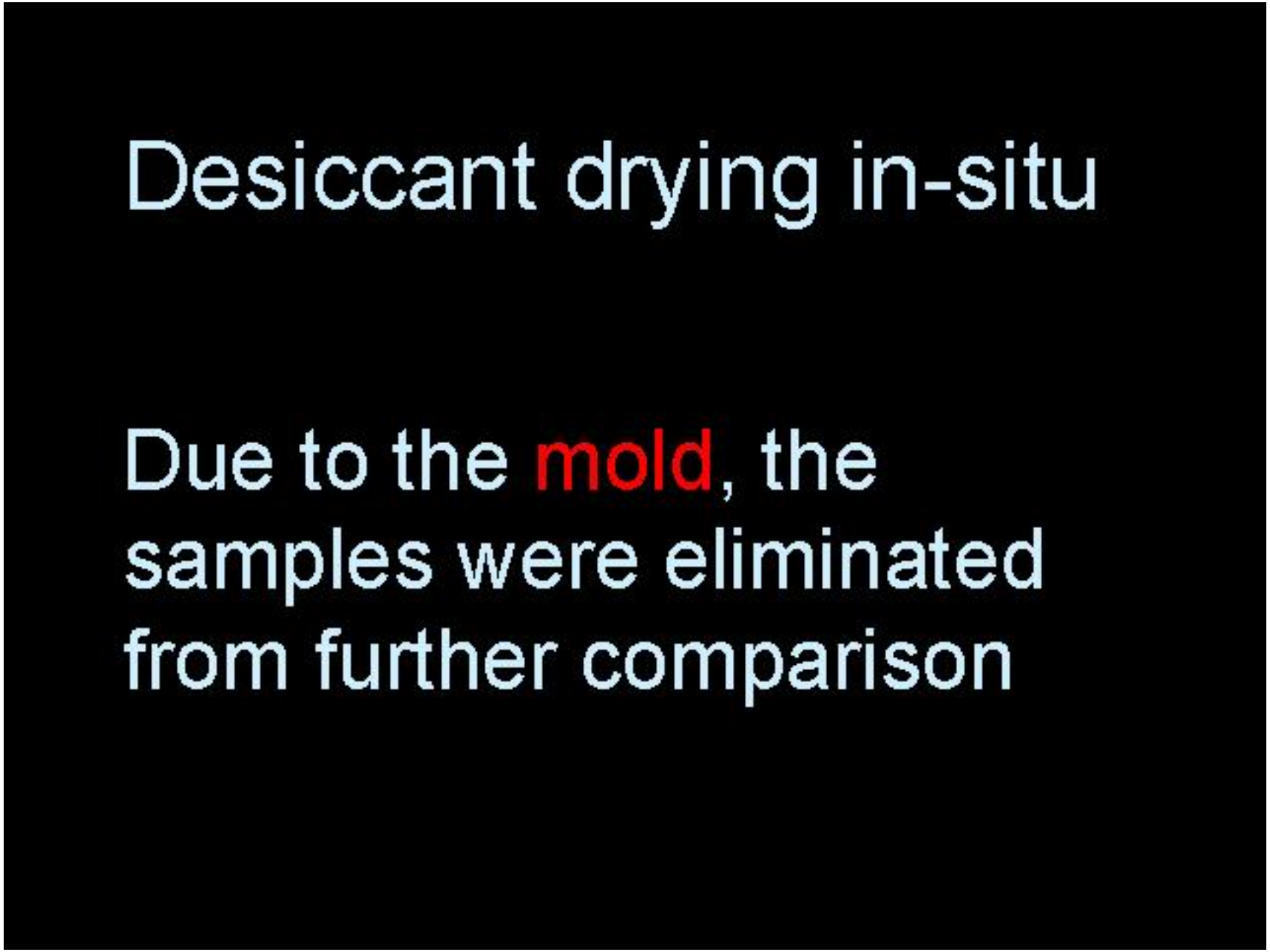
This is what the desiccant boxes looked like when they were removed from the chamber…all is well, but



When the items were remove a strong smell of mold emerged and several items were observed to be actively growing mold.



Parchment sample within folder of papers

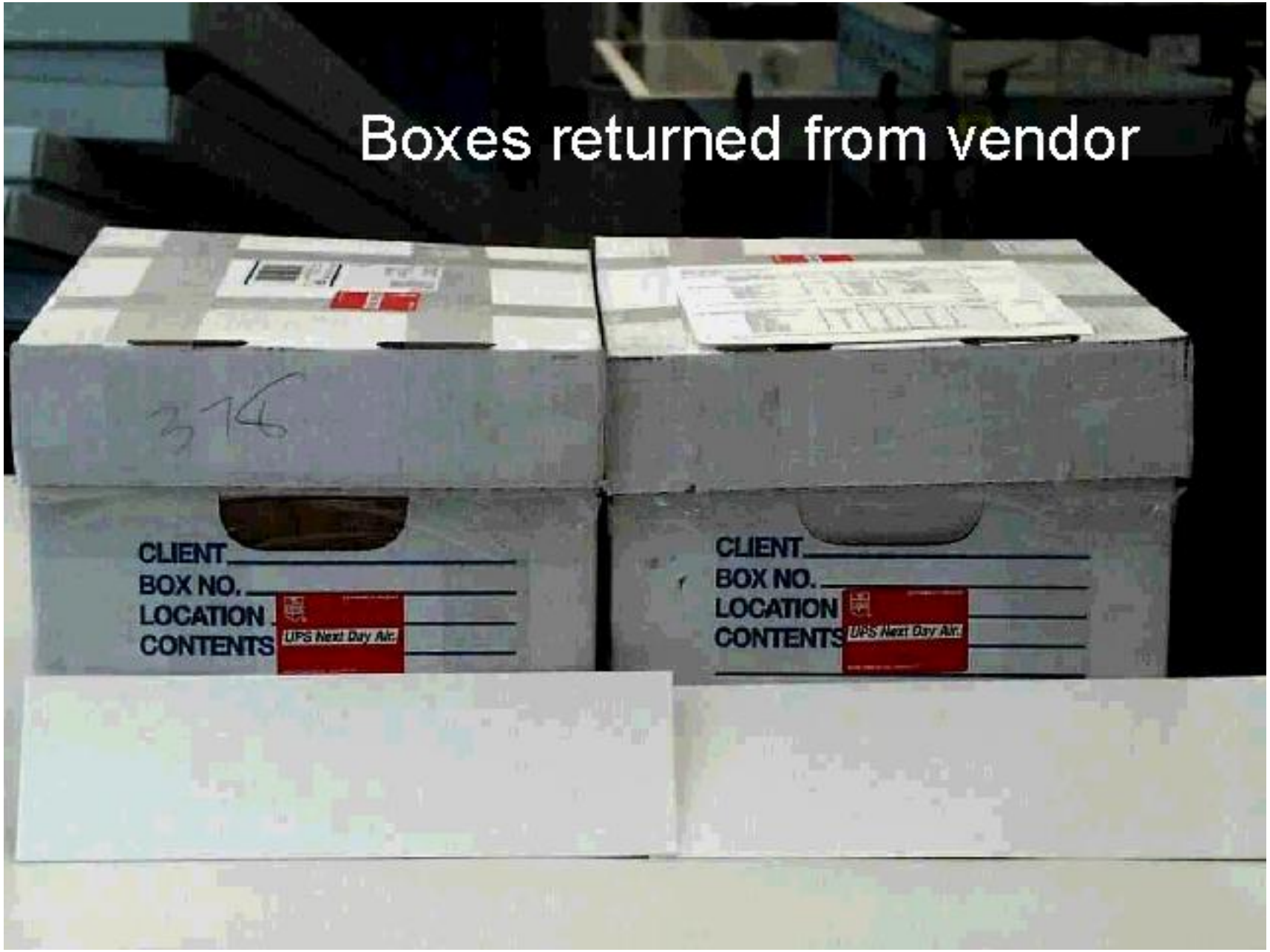


All of the contents were bagged and discarded.

I will next address visible observations and comparisons of the dried materials.

These are some comparative elements that I kept in mind while examining the processes.

Note: the holdings went out in 2 boxes and returned in 4. This was in part due to the distorted photographs and cocking that occurred in the records.



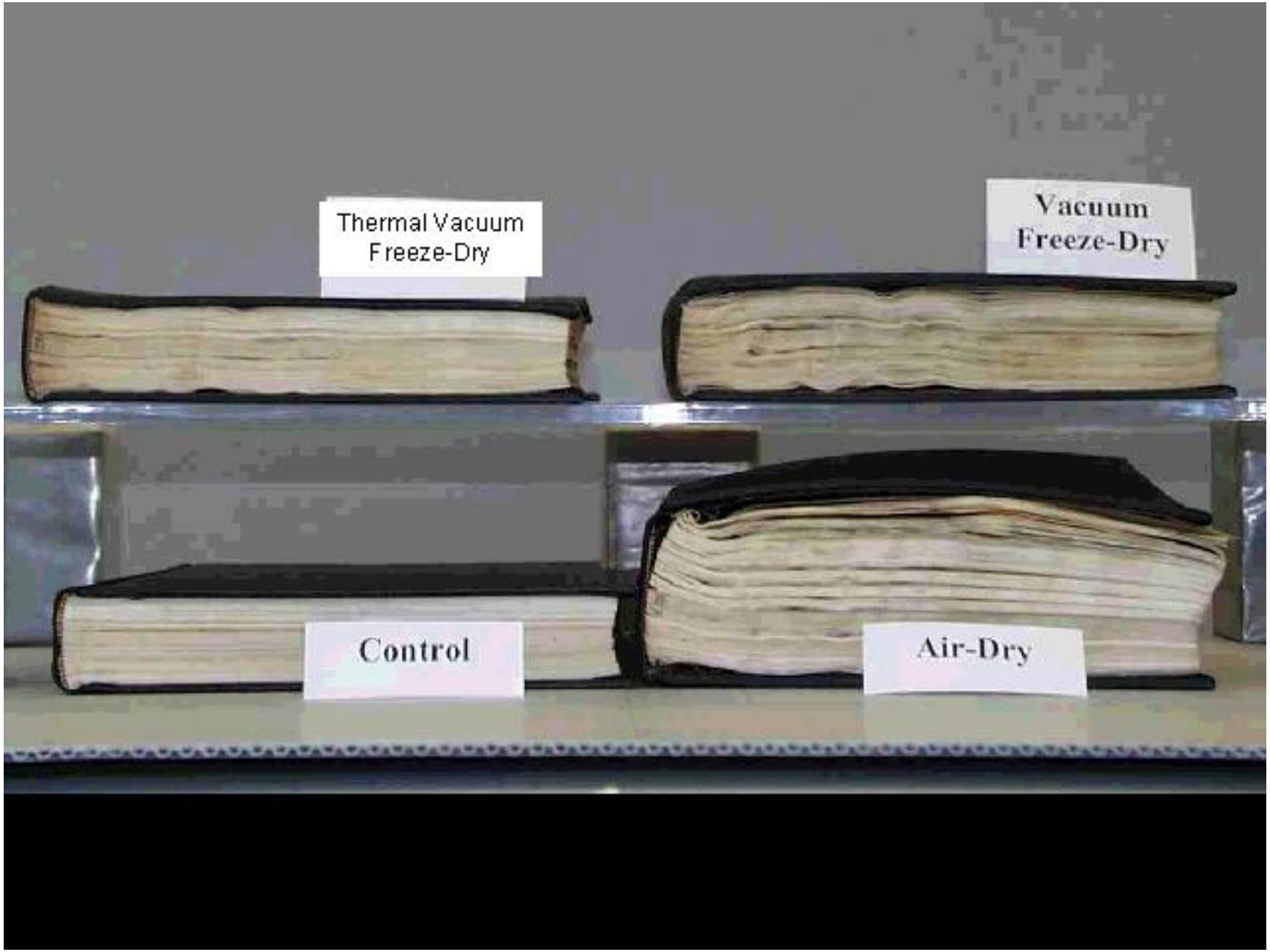
The vendors returned the items in new boxes. This was an added charge that I had not been made aware of.

Note the inclusion of original box labeling information.

Only one of these boxes contained a labeling fragment from its previous box. Vendor file numbers were written on the outside as were the shipping numbers, 1 of 4, 2 of 4 etc. but no other original information was preserved and returned by the vendor.

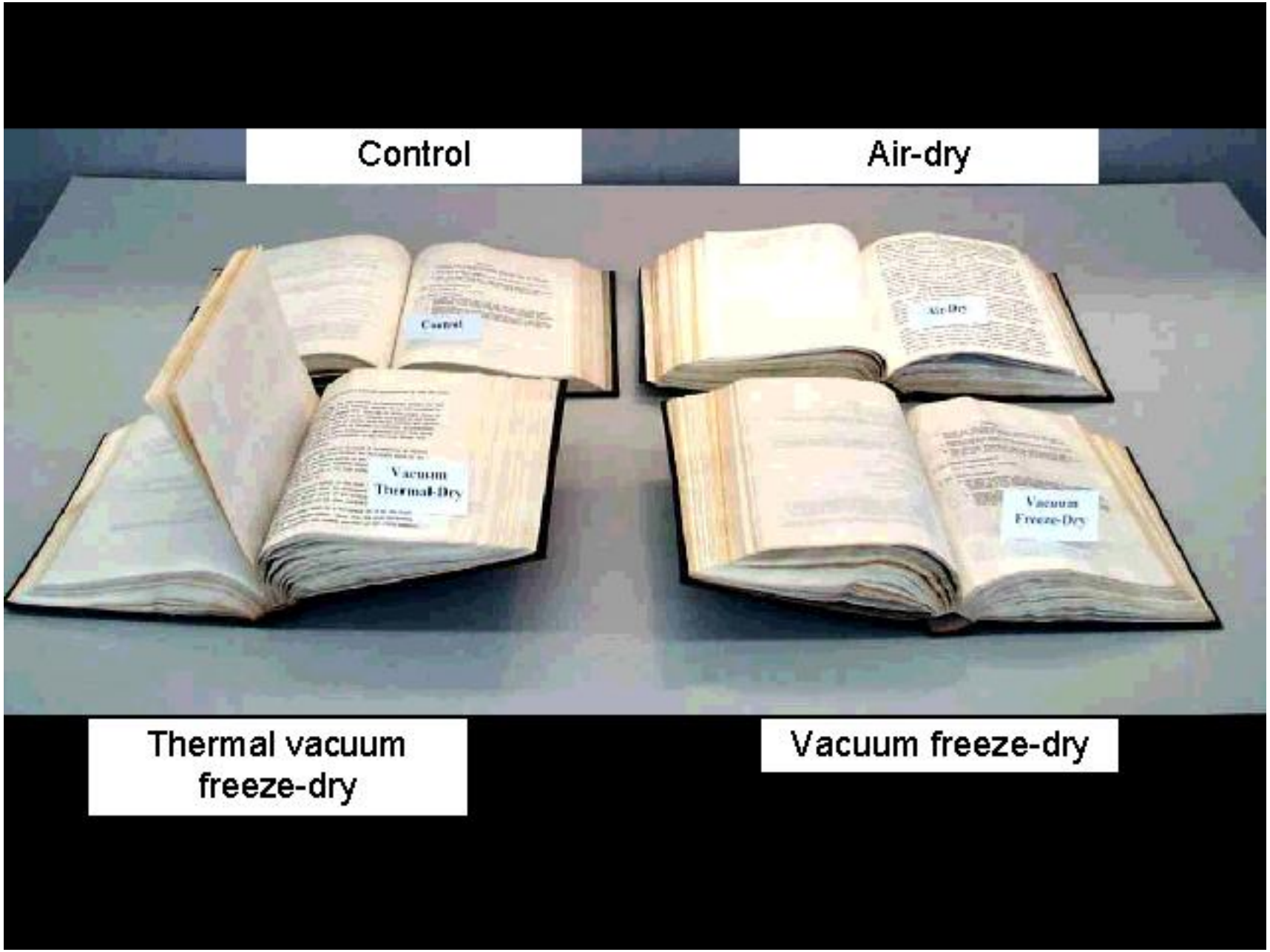
Note the order of items within these two boxes. I packed each box in an identical way, but here we see the items packed in a slightly different order. The box on the right has additional items tucked in to the right of the box. Some of these items actually belong to another box.

Bound Records

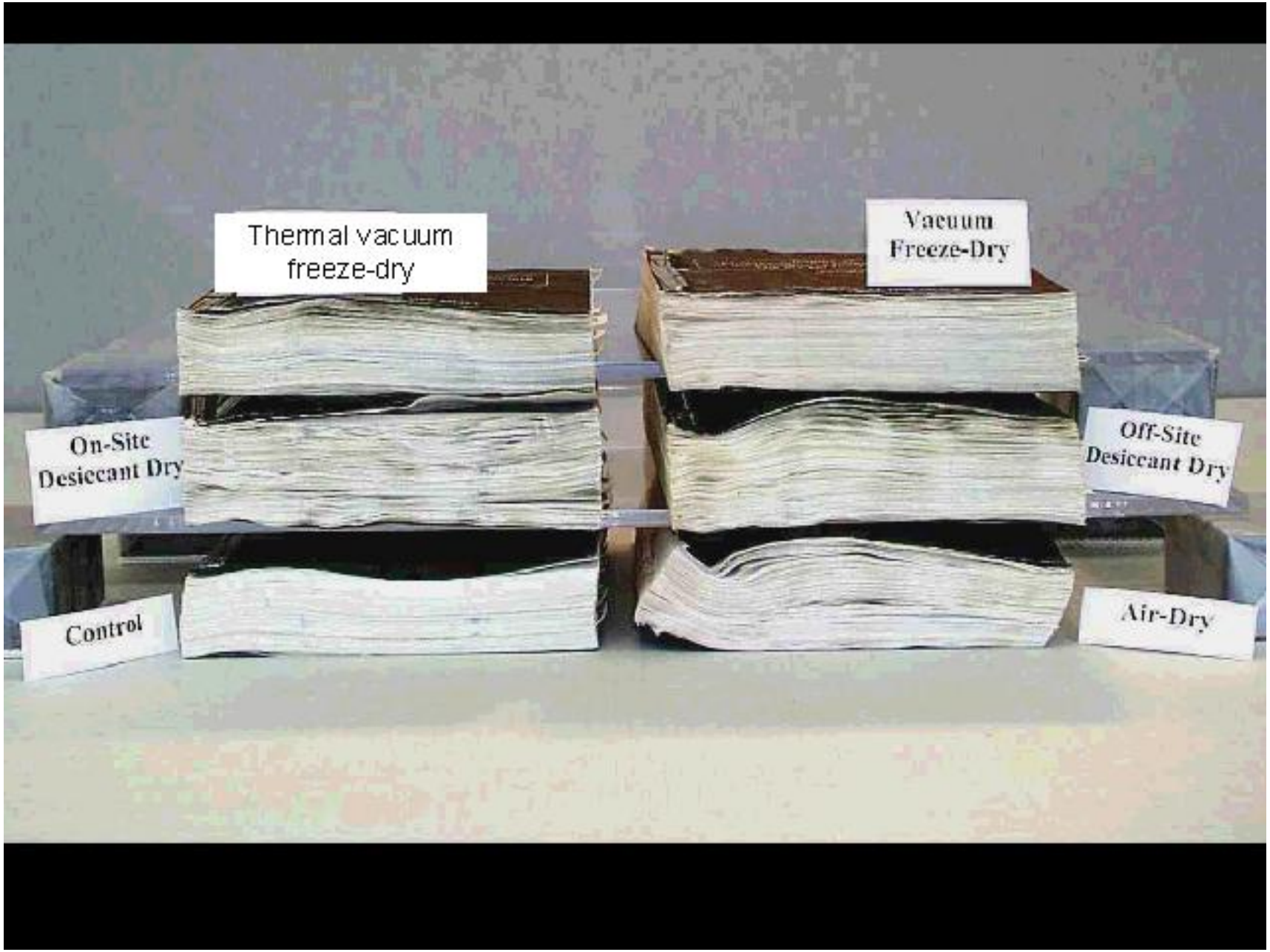


In this comparison, samples representing the desiccant dry system are absent. I only had 4 samples of this oversewn binding to include in the study.

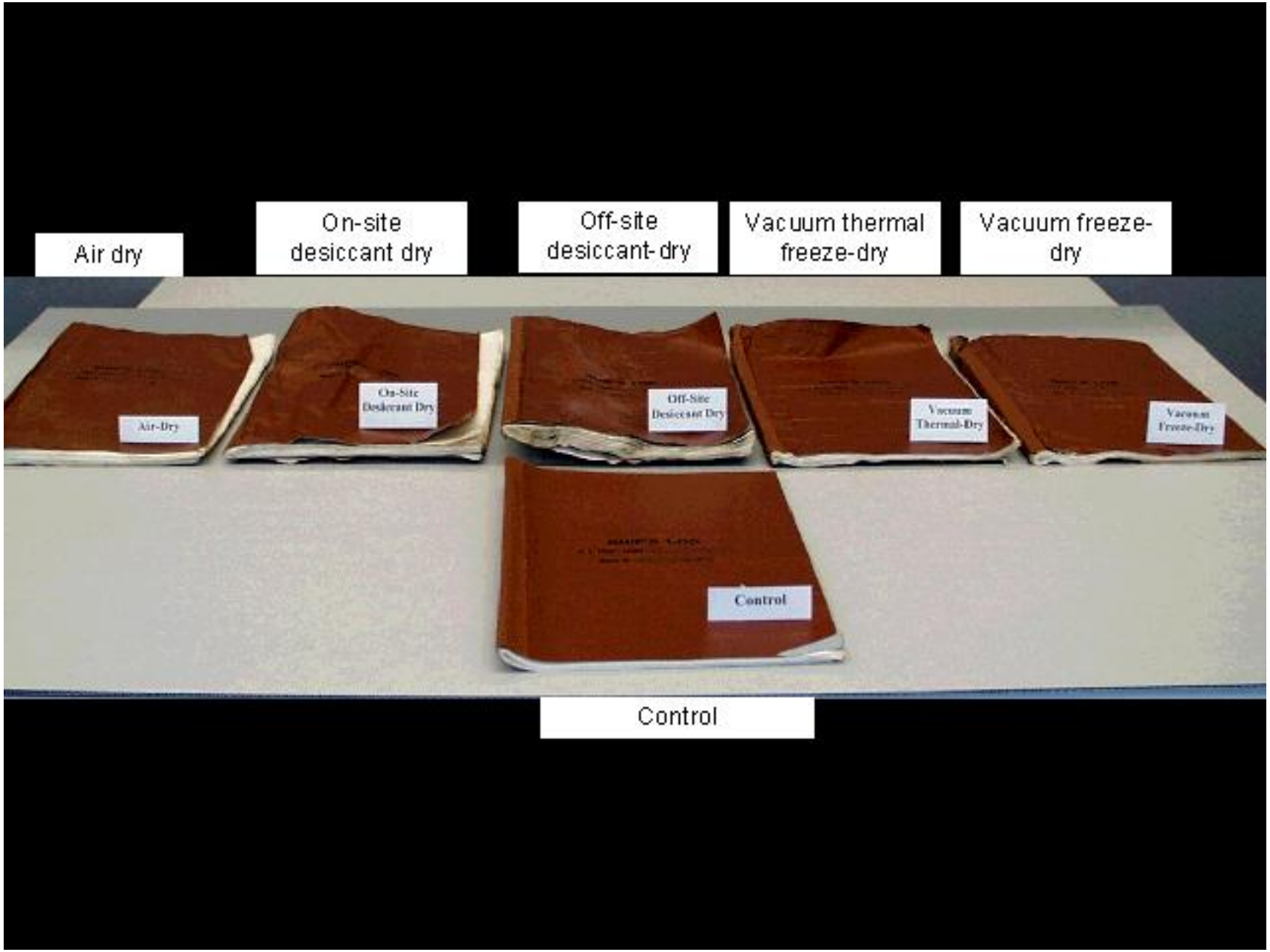
The thermal vacuum freeze-dry and freeze-dry samples look good, especially the thermal vacuum freeze-dry book, barely a perceptible change.
Remember, this is the process that employees a compression system in the drying process.



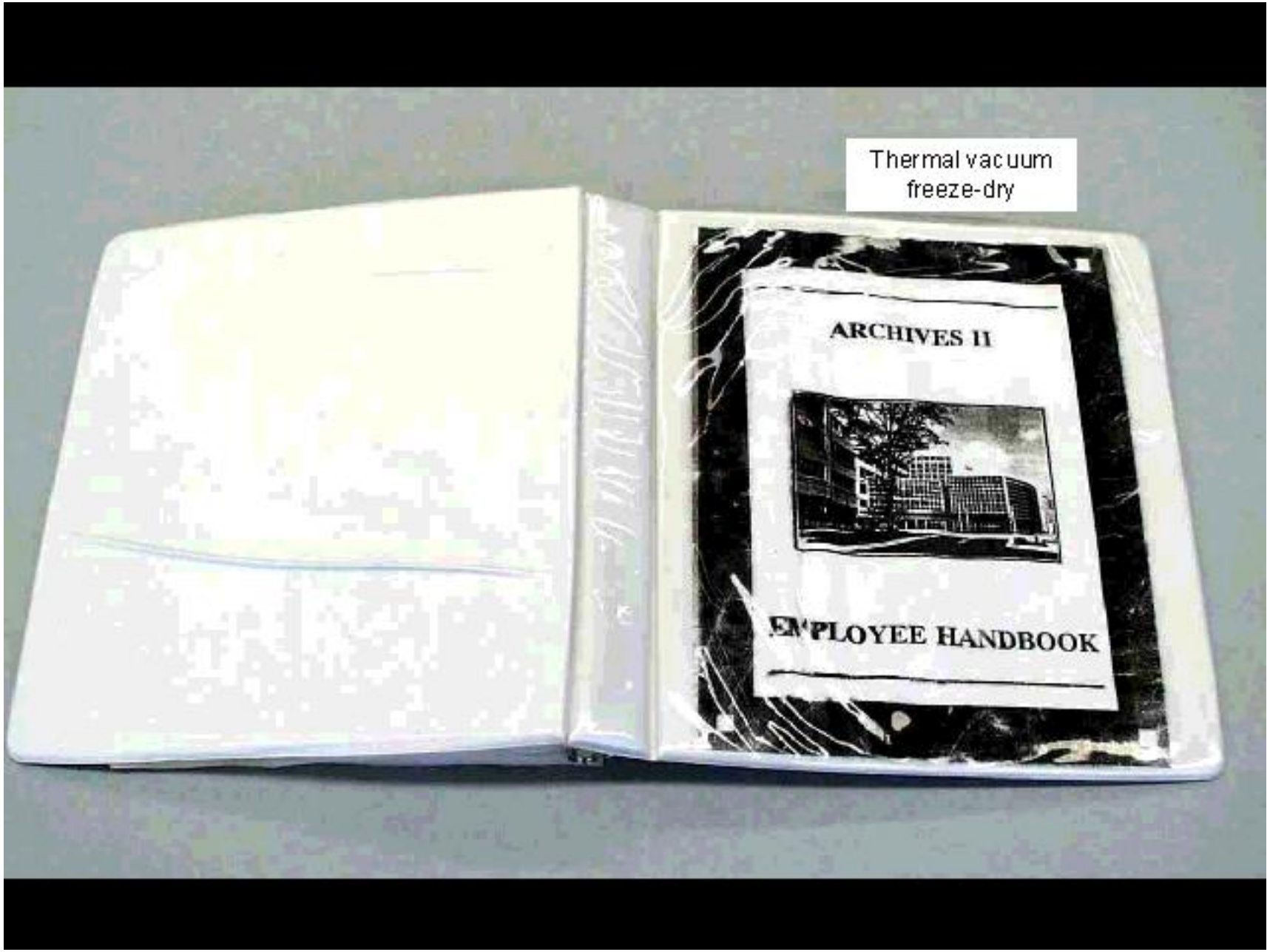
Note the openabiity of the two vacuum samples to the air-dry and control. Both the thermal freeze-dry and the vacuum freeze-dry samples felt stiff and exhibited a slight resistance to opening flat.



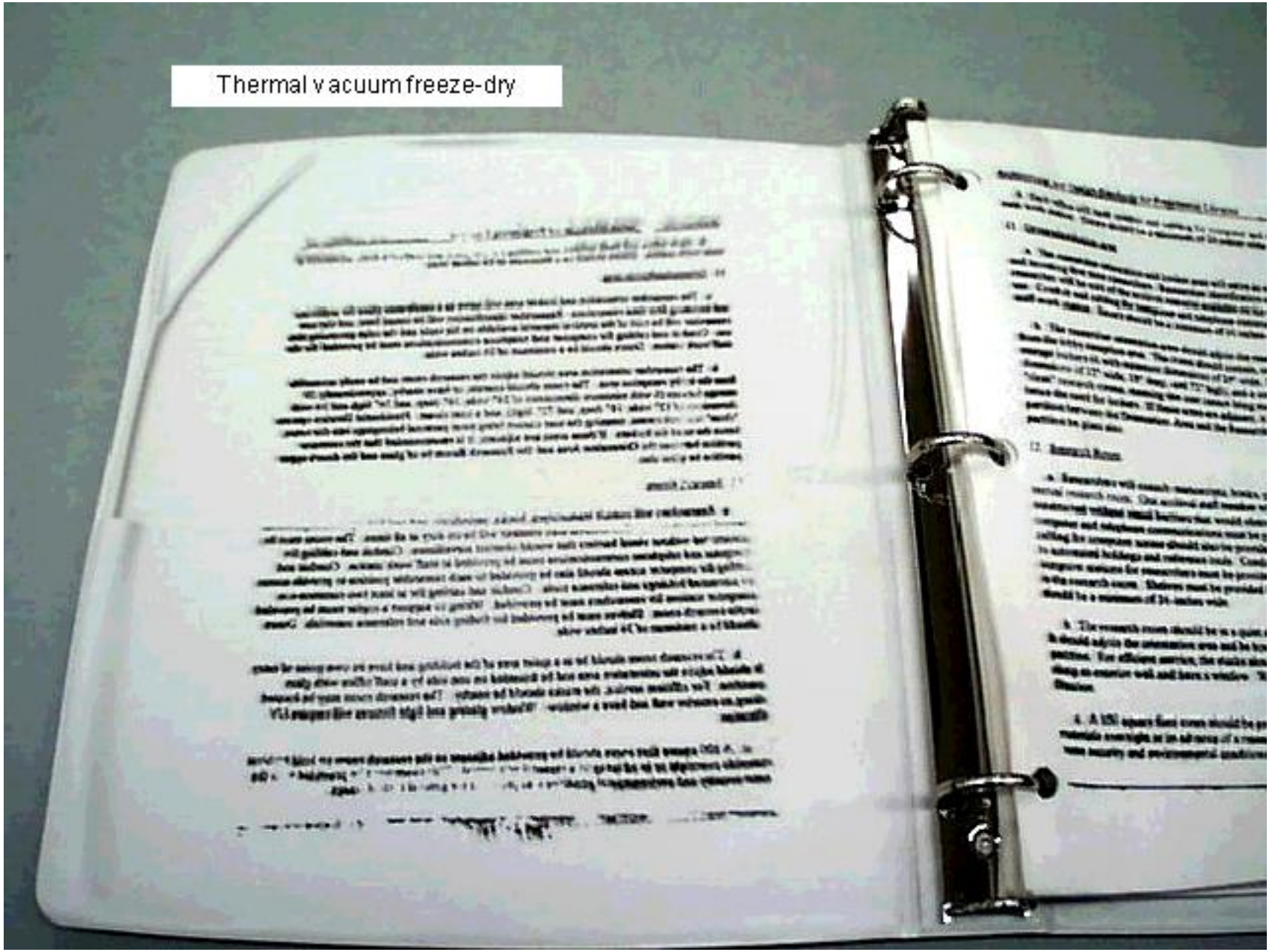
Here I had enough sample to expose to all the drying systems. This book is bound with a metal fastener, an ACCO fastener to be specific,and all look good. The most pronounced distortion exists with the air-dried volume, resulting from the flat open format that was used to dry the pages.



Again, another comparison of the bound format. All looking acceptable; the desiccant samples show the greatest distortion. It's undetermined if the distortion exhibited by the thermal vacuum freeze-dry sample is from the compression process or if the volume remains distorted from shipment.

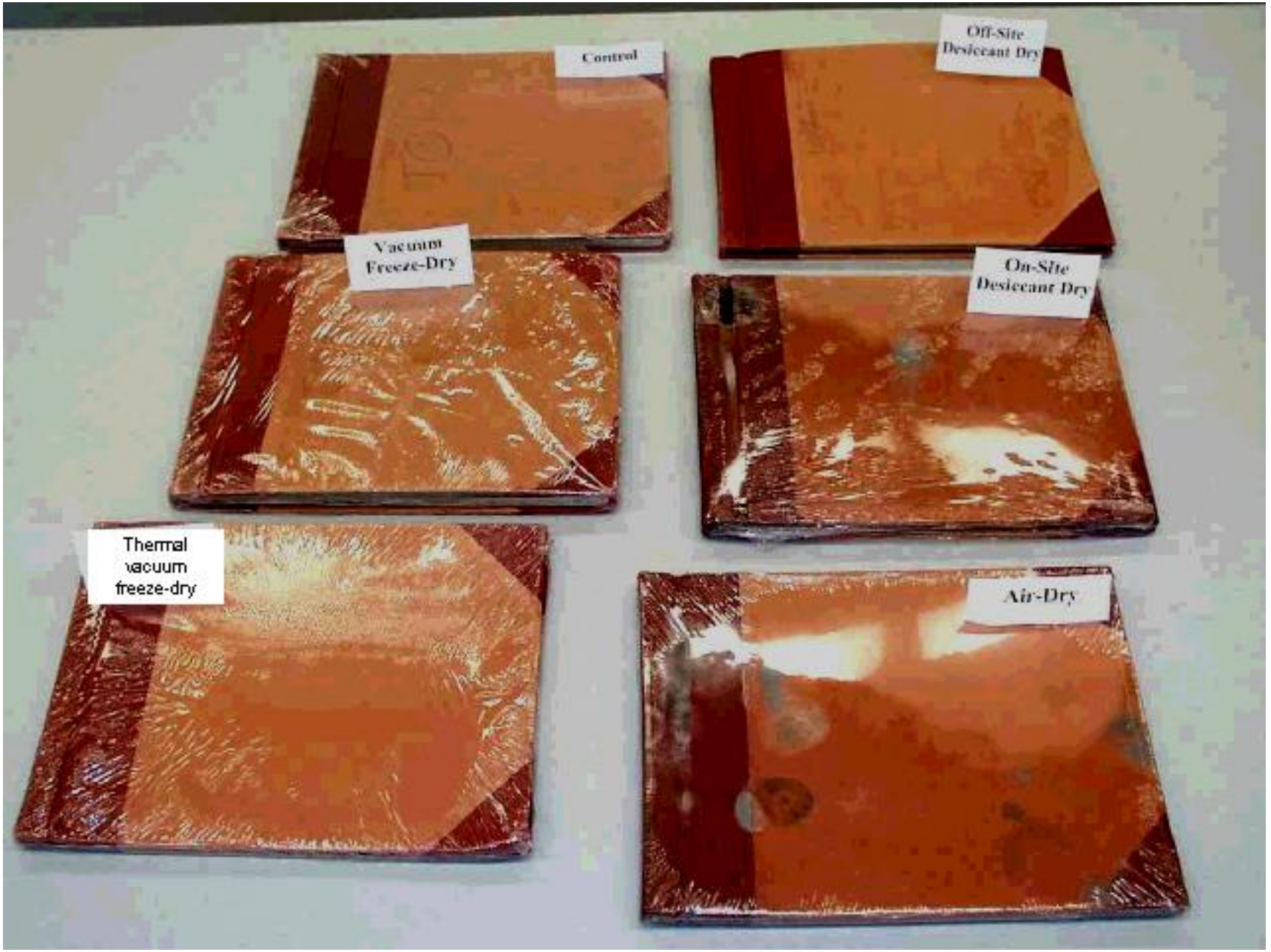


All vinyl 3-ring binders faired quite well except for the thermal vacuum freeze-dried sample. It appears that the some aspect of the process had an adverse effect on the vinyl and the on the toner of the Xerox insert.



The same effects can be seen on the inside of the cover. It appears as if the heat is a factor here, perhaps making the vinyl plasticizers more mobile. Yet, the pages with the same toner media are not blocked.

Shrink Wrapping

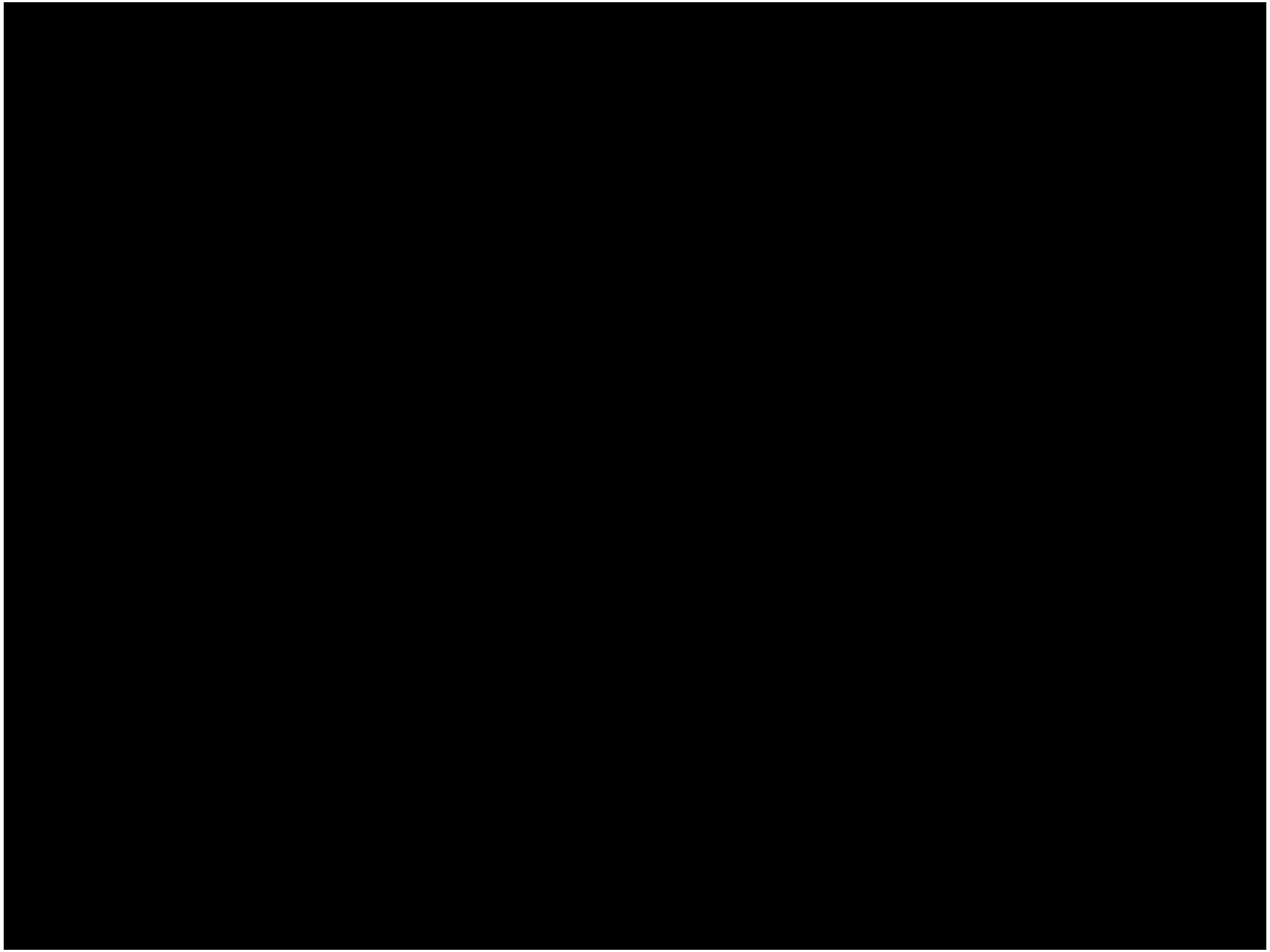


This image shows that the shrink wrapping needs to be removed in all cases except for those involving vacuum freeze-drying to effect safe drying.

The preservation literature is fairly consistent with the proper course of action in the recovery of water damaged photographs. Quick separation of the photographs and air drying is the most preferred method of minimizing damage to the prints. In order to gain some working time without incurring mold growth, photographs that have not been allowed to partially dry can be

immediately frozen. They can then be thawed at a more convenient time and place followed by immediate air drying. Vacuum freeze drying can be used to salvage photographs, however the process must be used judiciously because mottling of the photographs' surface will occur.

While an evaluation of our test samples confirmed this traditional advice, it may be useful to share a few observations



The most crucial aspect of successful air drying is the timely separation of photographs before they partially dry. Otherwise, the photographs will block, and even subsequent immersion in water may not allow for successful separation. If the photos were

frozen, they must be separated as they thaw, to prevent the prints on the edges from drying before the core of the stack is thawed.

Unrestrained drying is usually a safe procedure for photographs but frequently results in moderate to severe physical distortion, as evident in this image. Here you can see photographs dried in a blotter pack are much less curled than the samples that were air dried on a table or hung on clips.

Photographs that are curled cannot be adequately stored without further treatment to reduce distortions. This second phase of recovery can add significantly to the overall expense.

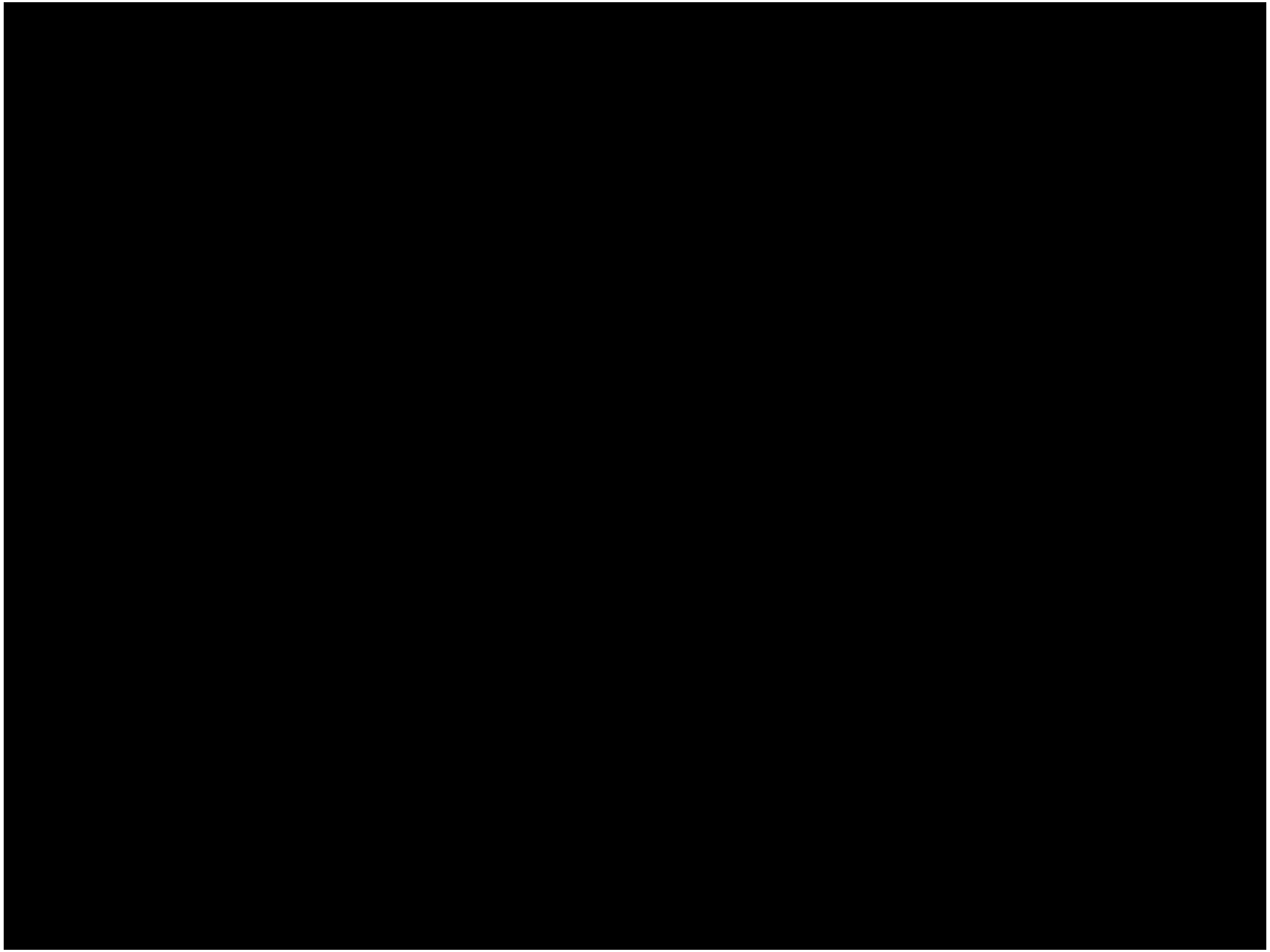
Severe curling is possible with desiccant drying as well. The photographs on the left were not restrained as they dried on-site and as a result are quite distorted.
The photographs on the right were restrained with clips and have only a slight overall curve. This flatter effect is the result of

each photograph being separated prior to drying and heat pressed once they were dry.
We were not aware of this part of the procedure. You need to be informed, in advance, of what the records will be exposed to in the event the procedure is unacceptable for certain materials based on type and/or intrinsic value.

As this slide indicates, the use of clips on damp photographs can easily result in the crimping of the photographs at the site of the clips, and in some cases, cracking and flaking of the emulsion.

The sample photographs that were vacuum freeze-dryed had no overall curl but they did have moderate to severe cockling, or

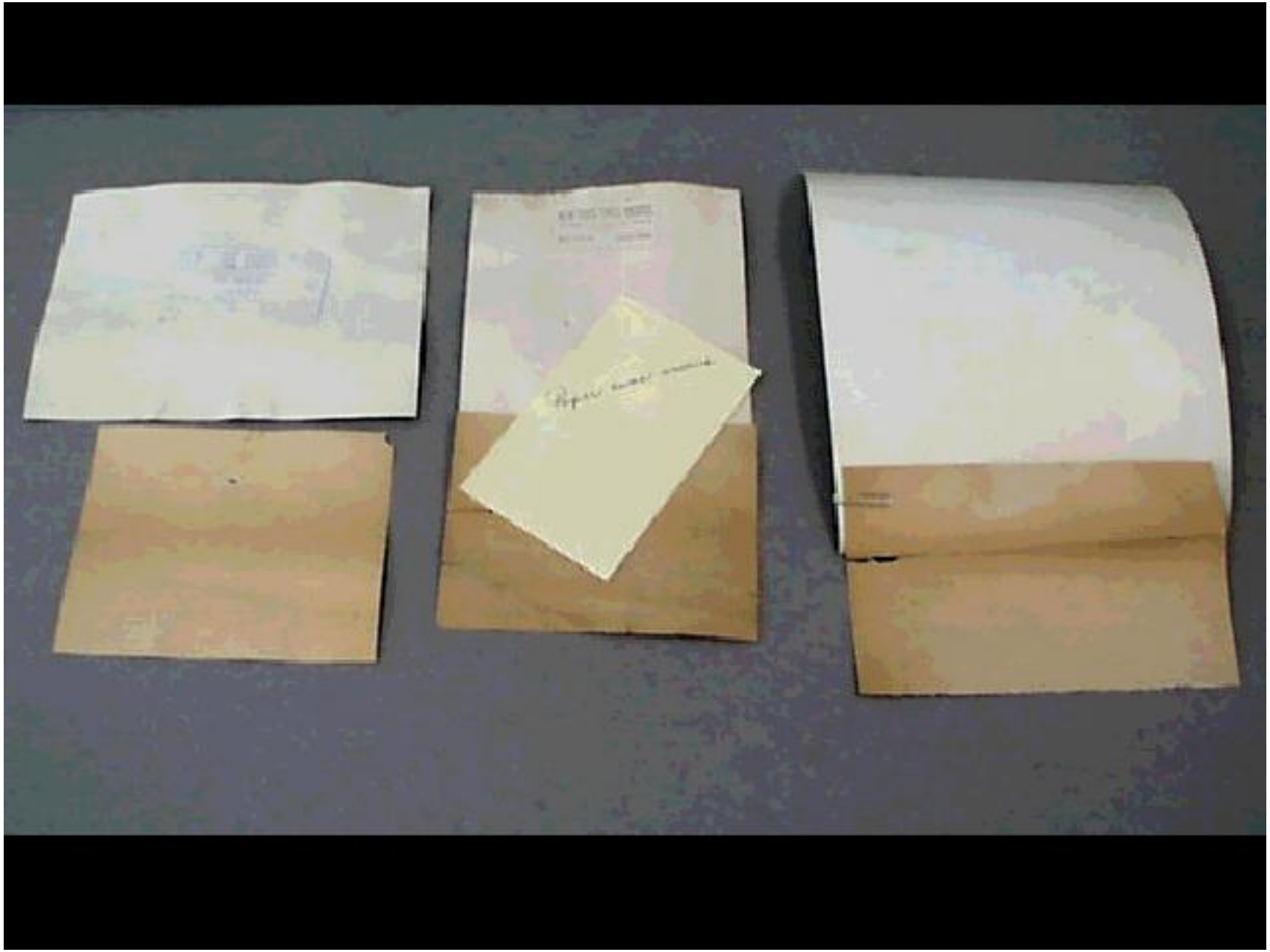
small undulations, as seen in the photograph on the right. The surface of the photographs also had a mottled appearance, in that there were patches of glossy and matte areas.



Some of the sample photographs were in enclosures. Photographs left in Mylar L-sleeves generally dried well within the L-sleeves but with some surface gloss changes. This was true for all recovery processes, except for off-site desiccant drying because the vendor removed the L-sleeves. Photographs were removed from paper enclosures by the vendors but while one vendor placed

all photographs back in their paper enclosures prior to being returned, the other did not.

Identification of photographs either as labeled enclosures or attachments can be critical for the proper use of the photographs. Many of the sample photographs had paper labels attached with a water-soluble adhesive. This proved to be a challenge for successful recovery efforts. It was not uncommon for the attachments to become separated from the photograph during the initial wetting process. Attachments need to be kept with their corresponding images, especially if the information on the attachments is very similar, technical or in a foreign language. For example, the labels with French inscriptions for these two photographs were switched. In a real post-recovery operation, this could lead to the need for increased staff time reorganizing the material or even result in the dissemination of inaccurate information about an image.



In the test samples, some attachments were not resecured. In other cases, vendors kept the attachment with the photograph with the aid of post-it notes or paper clips. The benefit of this is that the information is kept with the image. The disadvantage is that more time will be need for staff to correctly reassociate the information and rehouse the photographs in the post-recovery phase.

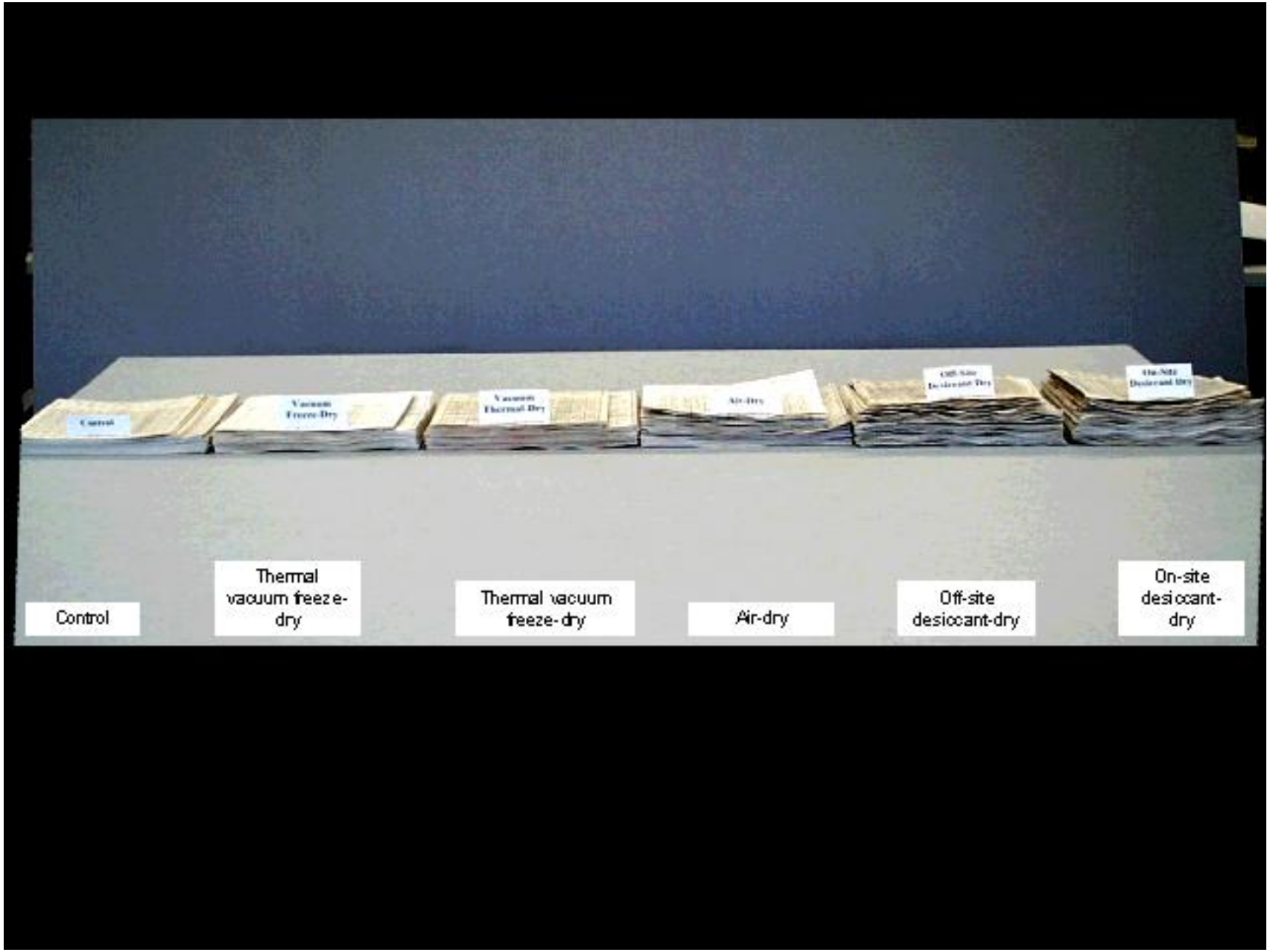
If many photographs with attachments or labels are to be recovered, it may be worth specifying to the vendor how the information is to be kept together, either with the use of enclosures, archival tape or another mechanism of choice.

This could add significantly to the overall recovery cost of the photographs. In fact, even without this added service, it is not uncommon for vendors to add a surcharge per photograph to be recovered. One should clearly specify how many and what types of photographs are included when seeking recovery estimates from vendors.

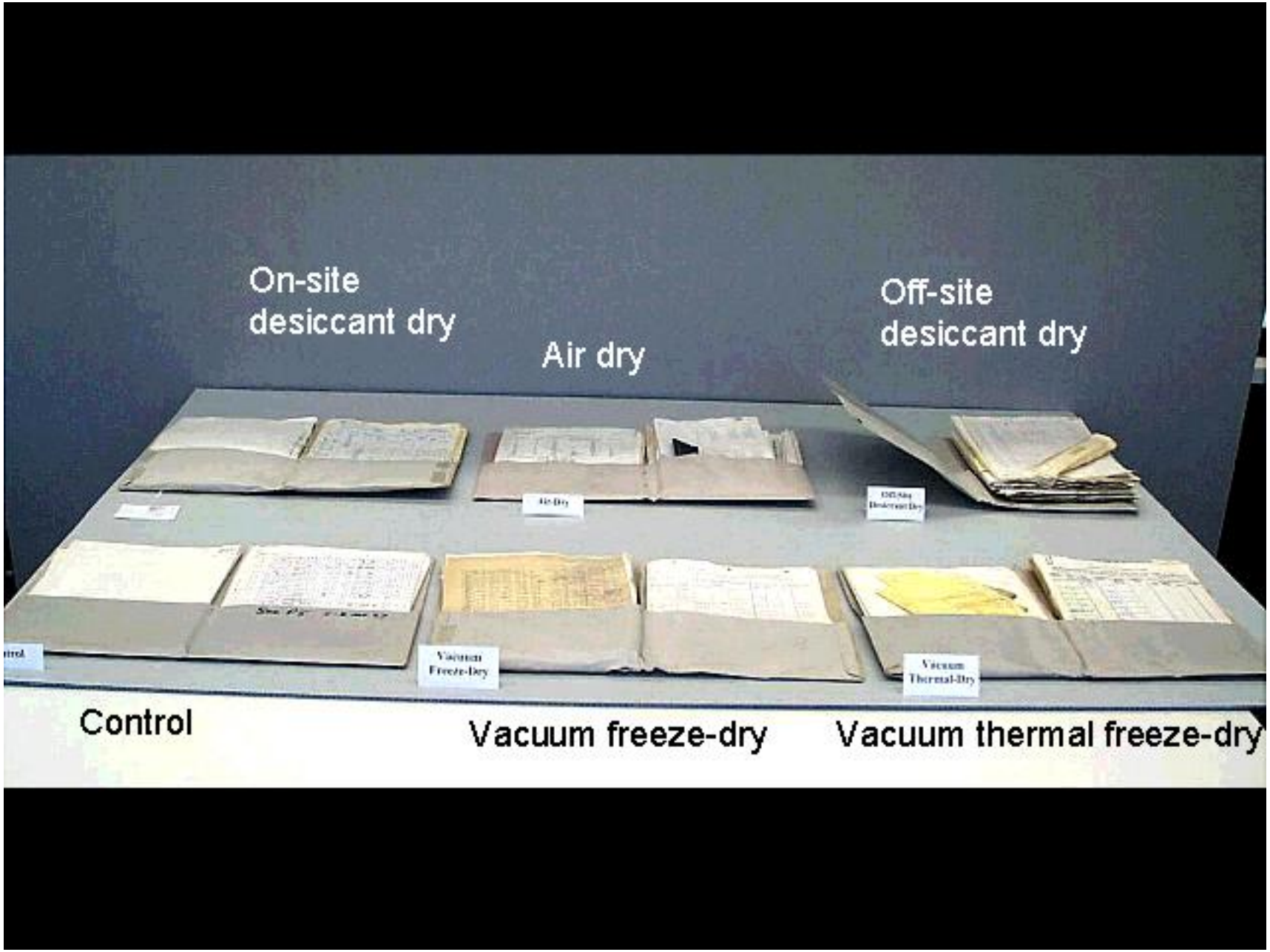
Paper Records

Basically all of the processes displayed a good end result regarding the drying of loose sheets with tapes and soluble inks. It is not possible to determine if the bleeding was exacerbated by the drying process or the dwell time in a wet state during transit. Pressure sensitive tapes did not appear to be altered. This slide shows how a group of materials faired that were inserted under the

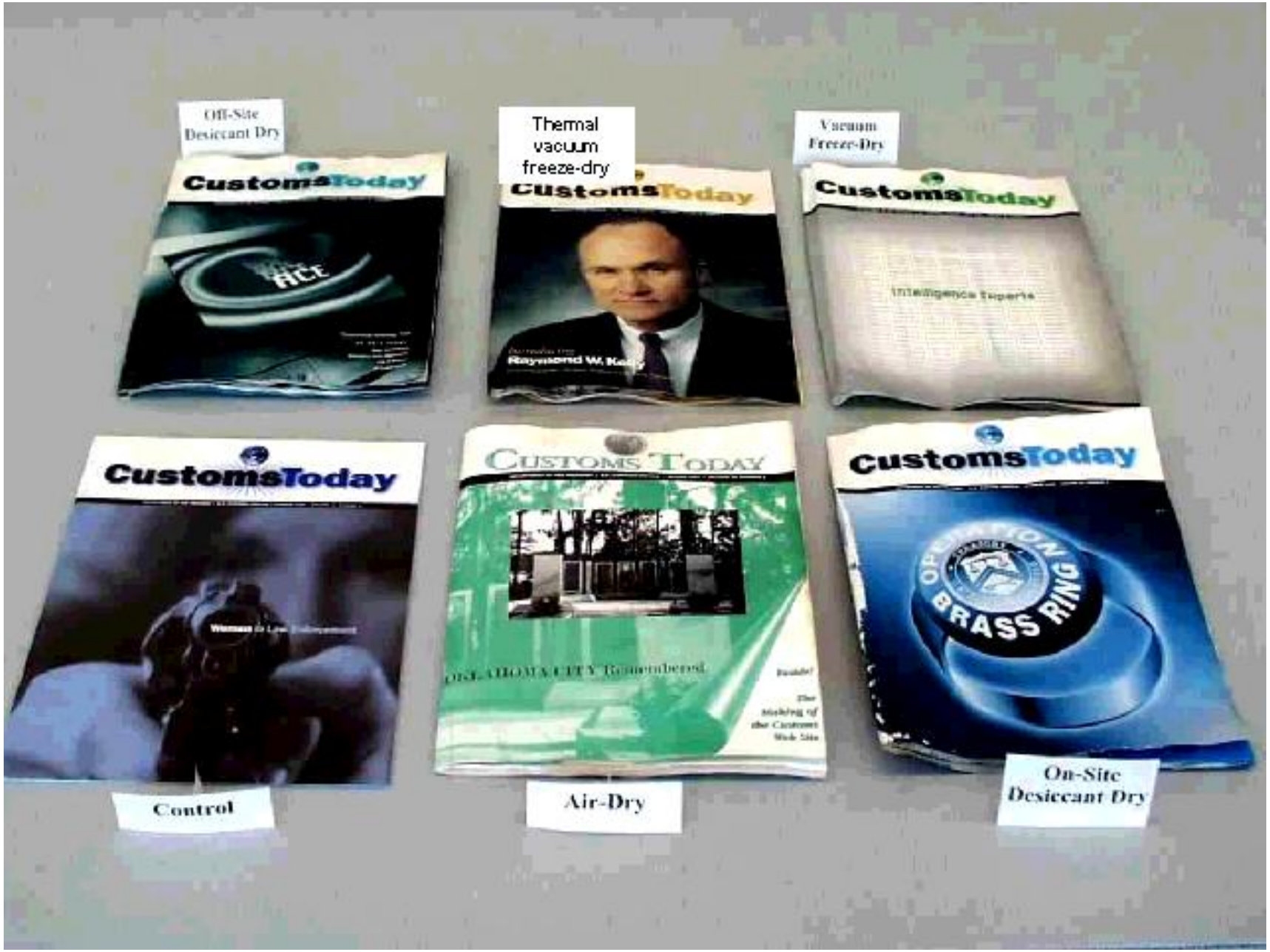
flap of a gummed envelope. The only sample that stuck was the on-site desiccant drying as things were put out on the shelves in clumps and did not receive item intervention.

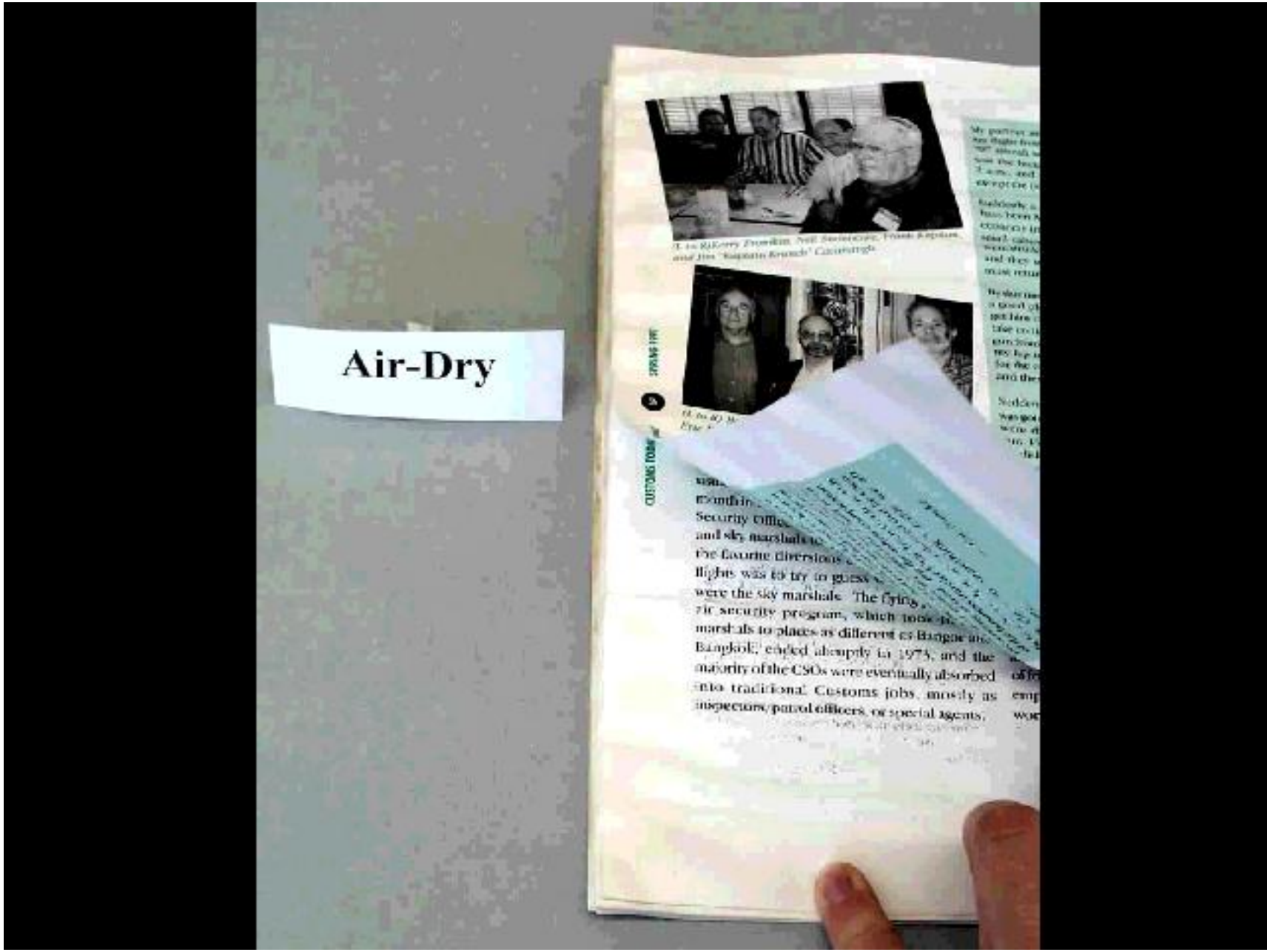

Control
Thermal vacuum freeze-dry
Thermal vacuum freeze-dry
Air-dry
Off-site desiccant-dry
On-site desiccant-dry

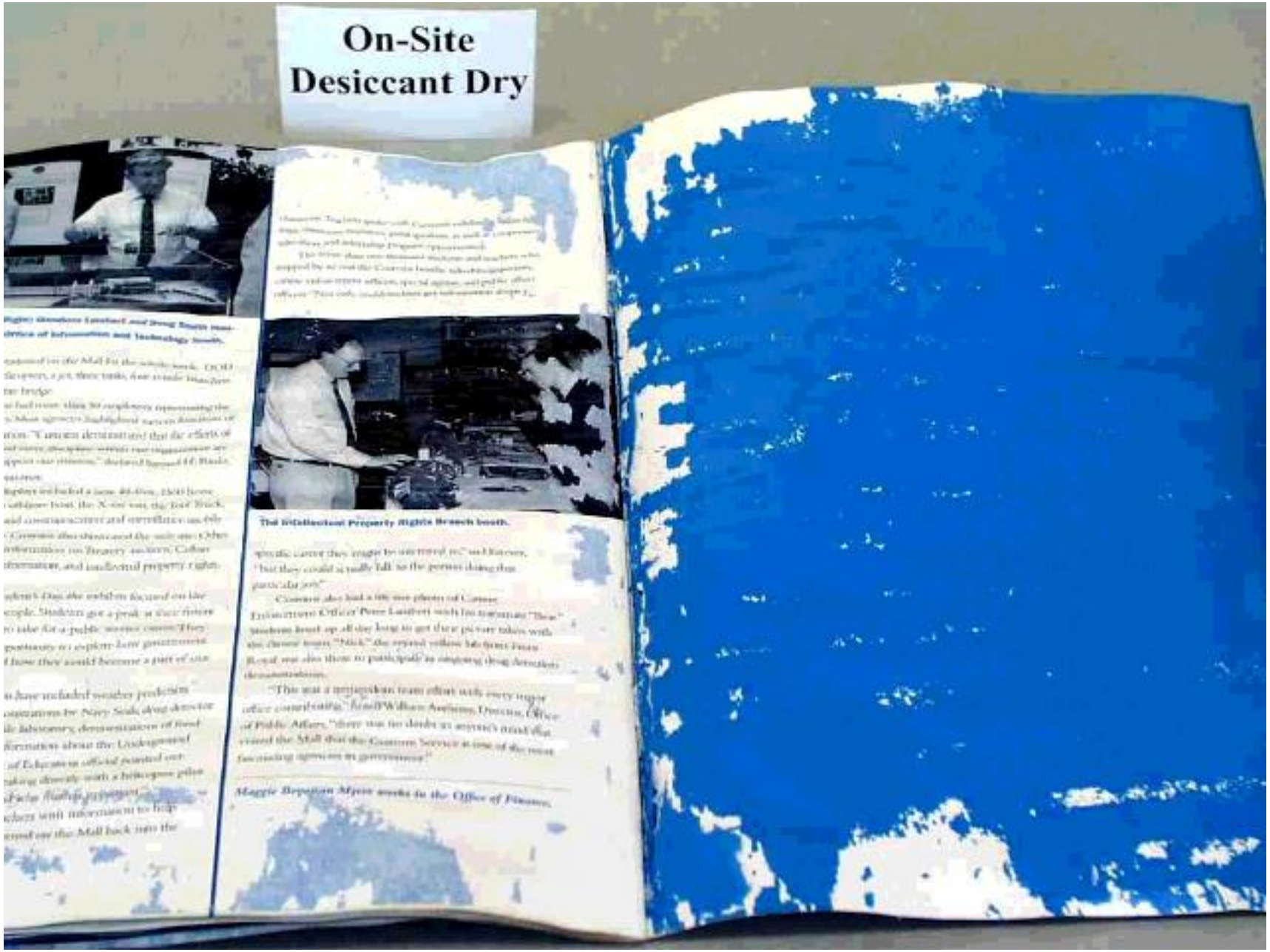

Control
Off-Site
Desiccant Dry
Air-Dry
Vacuum
Thermal-Dry
On-Site
Desiccant Dry
Vacuumthermal
freeze-dry


On-site
desiccant dry
Air dry
Off-site
desiccant dry
Control
Vacuum freeze-dry
Vacuum thermal freeze-dry

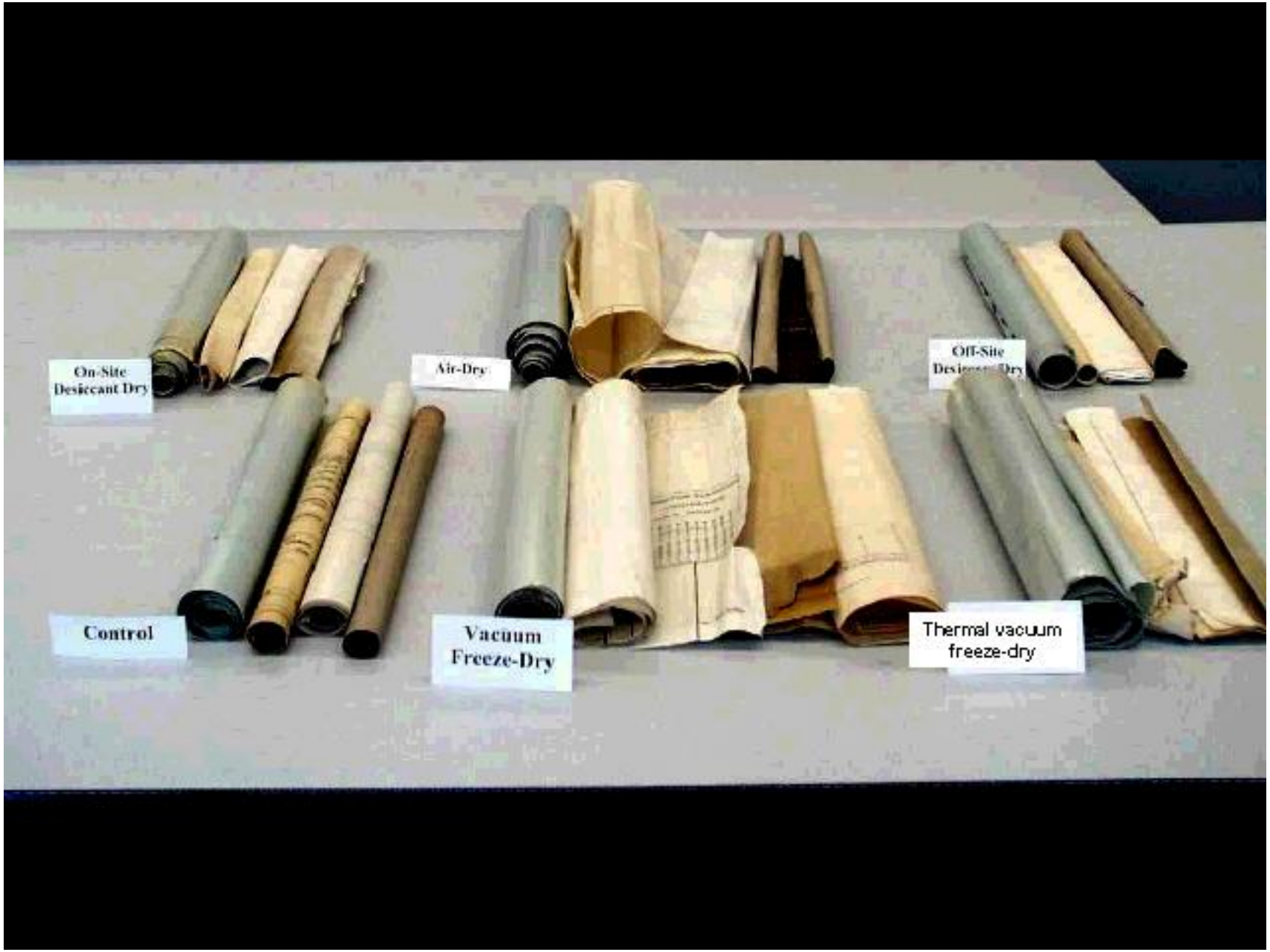
Coated Paper


Off-Site
Desiccant Dry
Thermal
vacuum
freeze-dry
Vacuum
Freeze-Dry
CustomsToday
CustomsToday
CustomsToday
Intelligence Experts
CustomsToday
CUSTOMS TODAY
CustomsToday
BRASS RING
Control
Air-Dry
On-Site
Desiccant Dry


Air-Dry


On-Site
Desiccant Dry

Rolled Records


On-Site
Desiccant Dry
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Off-Site
Control
Vacuum
Freeze-Dry
Thermal vacuum
freeze-dry

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Vacuum thermal
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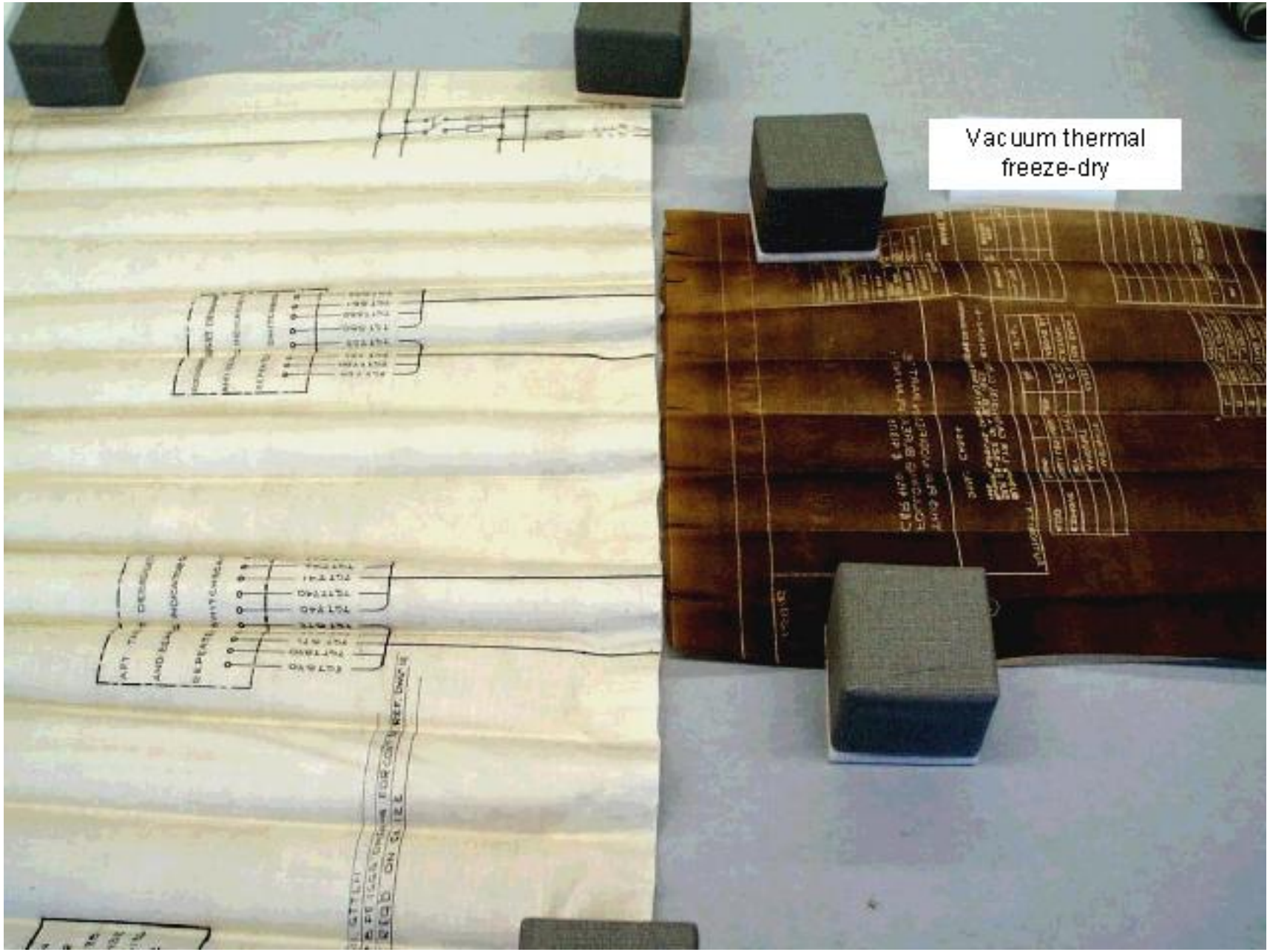
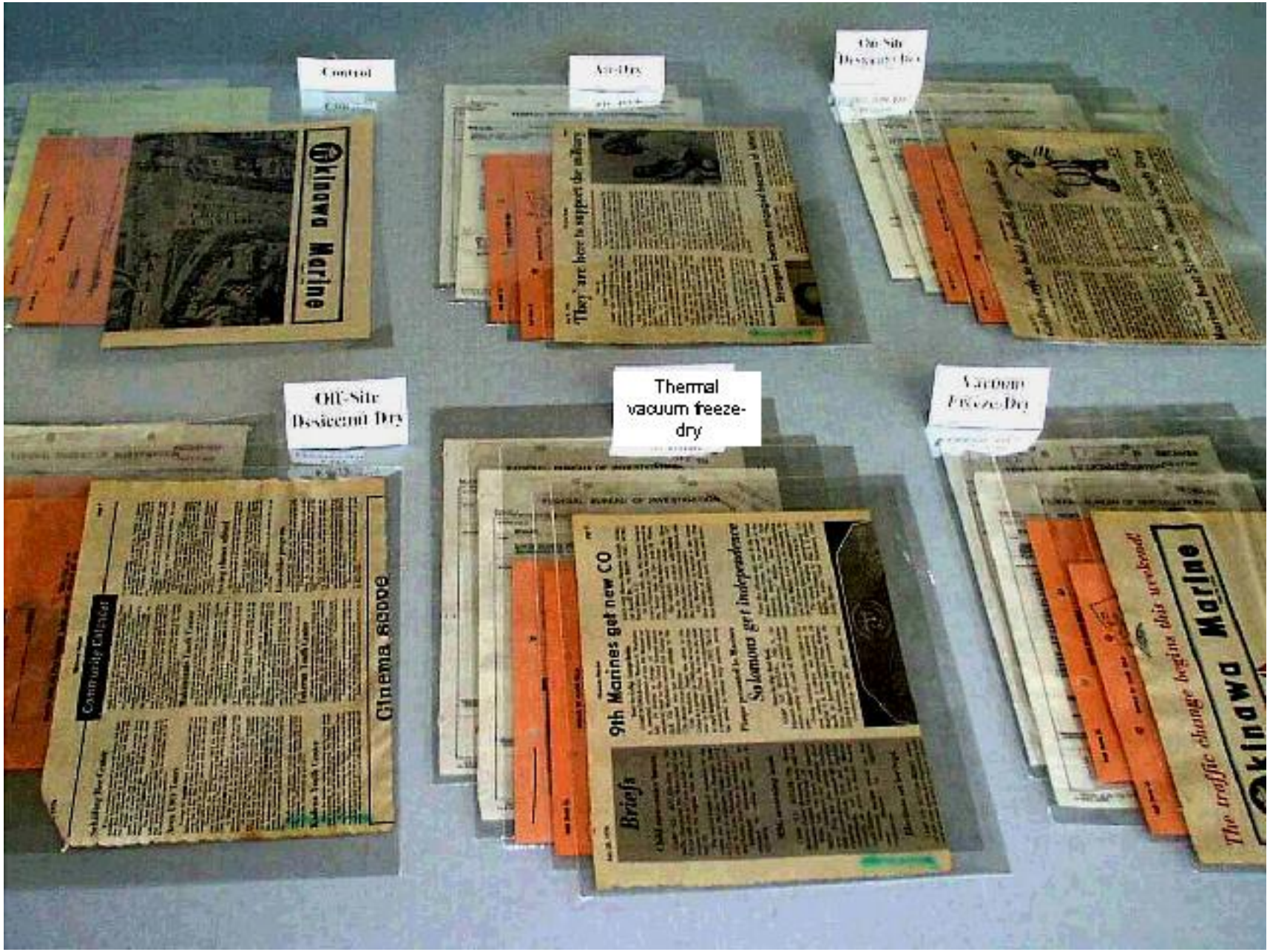
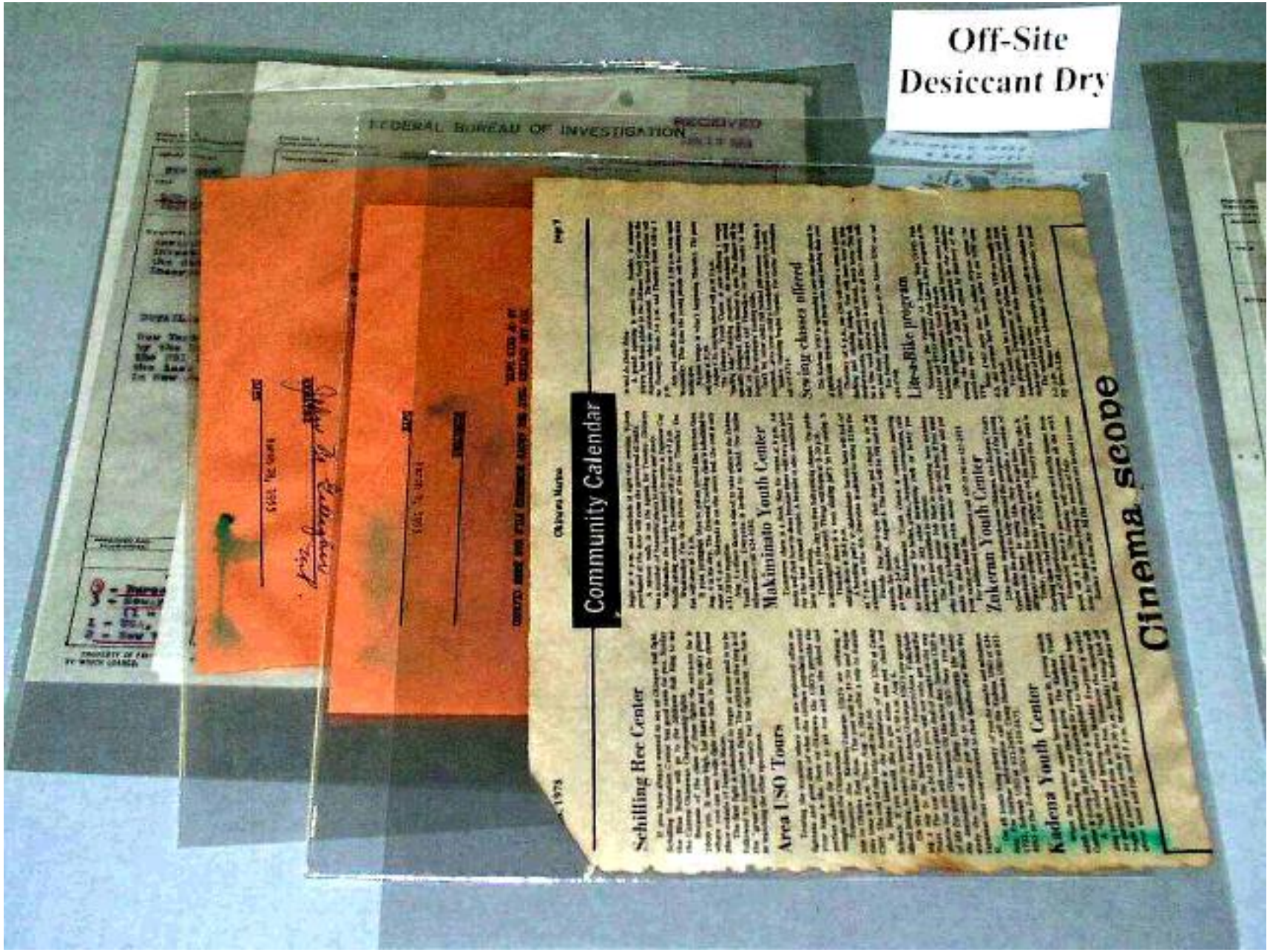
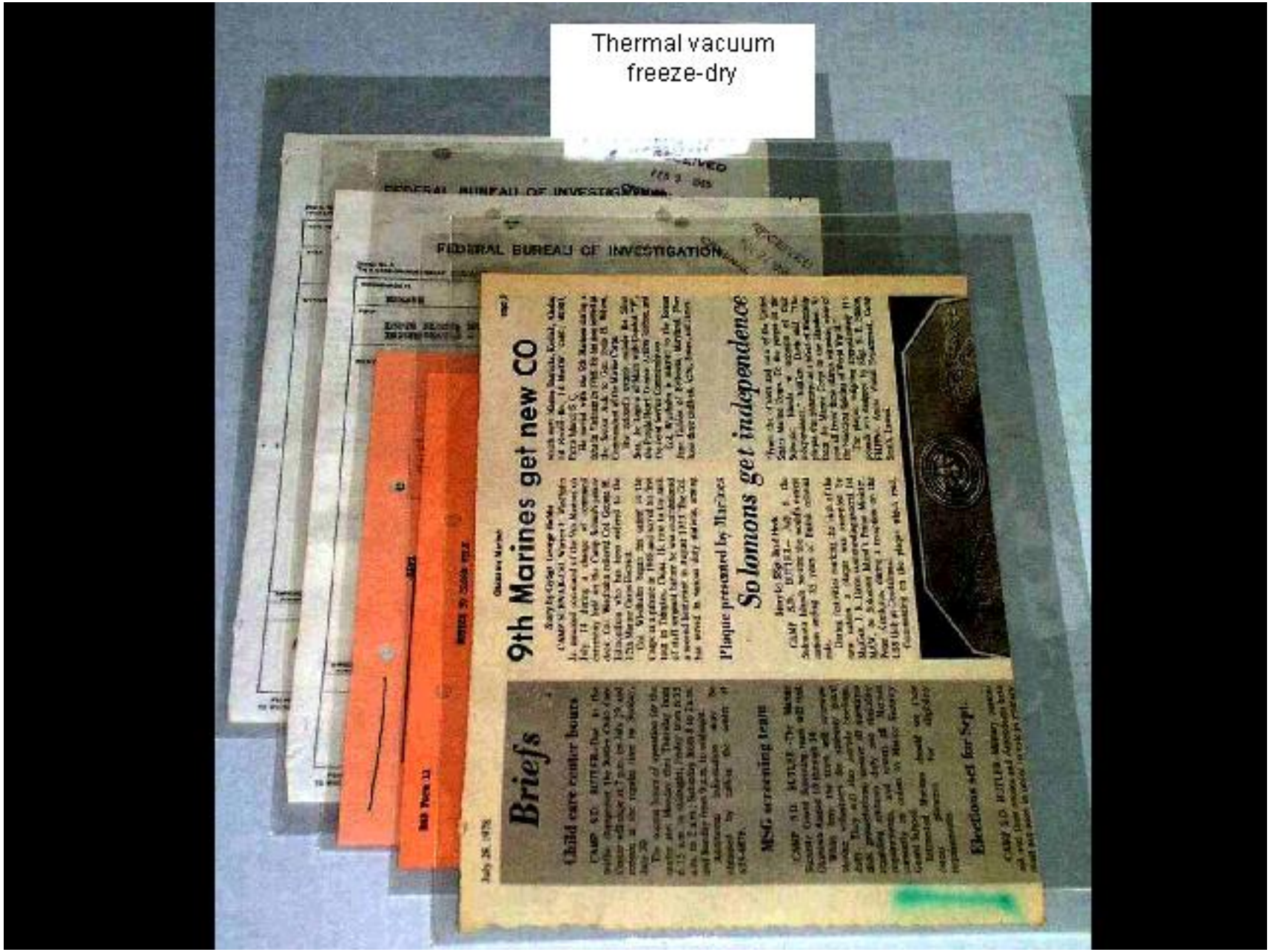

Vacuum thermal
freeze-dry


Vacuum Thermal
Freeze-Dry
Vacuum
Freeze-Dry
Air-Dry

Polyester L-sleeves


Control
Air-Dry
Off-Site Desiccant Dry
Thermal vacuum freeze-dry
Vacuum Freeze-Dry
Okinawa Marine
They're here to support the effort
Cinema scope
9th Marines get new CO
Briefs
The traffic shower begins this weekend
Okinawa Marine


Off-Site
Desiccant Dry
FEDERAL BUREAU OF INVESTIGATION
RECEIVED
Community Calendar
Cinema scope
Schilling Rec Center
Area USO Tours
Makiniaito Youth Center
Zukerman Youth Center
Kadena Youth Center
Sewing classes offered
Life-a-Bike program


Thermal vacuum
freeze-dry
FEDERAL BUREAU OF INVESTIGATION
9th Marines get new CO
Solomons get independence
Briefs


Vactum
Freeze-Dry
FEDERAL BUREAU OF INVESTIGATION
RECEIVED
FEDERAL BUREAU OF INVESTIGATION
The traffic change begins this weekend!
Okinawa Marine


FEDERAL BUREAU OF INVESTIGATION
Air-Dry
July 28, 1976
Okinawa Marine
page 1
'They' are here to support the military
Story by
LCpl. Yvonne Baker
CAMP S.D. BUTLER--During our first president's administration only 350 civilians were employed by the government, but today that figure numbers in the millions.
Some people may believe that civilians don't have a useful function in military life but according to the Department of Defense (DoD), "The use of civilian employees affords abilities not otherwise available, assures continuity of administration and operations and provides a nucleus of trained personnel necessary for expansion in any emergency."
Here on Okinawa, the Marine Corps and Navy rely on the Consolidated Civilian Personnel Office (CCPO) to provide top quality civilians to fill a variety of billets.
"The Civil Service Commission (CSC) sets the qualification standards that must be met by all our applicants," explained Doreen Mossman, personnel staffing specialist with CCPO.
There are several different types of people who work for the military here. One type is the old timers who have always been on the island and who form the 'basis of' the work force here. Some of these people have worked for the government here since the conclusion of World War II.
Then there are the civilian personnel from the states who choose to rotate overseas to enhance their career. A civilian employee's tour overseas is a minimum of two years and a maximum of five years.
Next comes the Dependent Hire Program which is geared to hire the dependents of the currently employed DoD personnel and military dependents. Contrary to some beliefs, the CCPO must hire a certain number of Japanese who perform many of the jobs available. This law was established by the Status of Forces agreement in 1960.
The CCPO's mission in essence is simple, they are here to support the military. "We provide civilians for all the Marine Corps bases on this island. We also provide the hospital staff at Camp Kinser and all the civilian workers in the various Naval facilities," concluded Ms. Mossman.
Unfortunately the CCPO has more workers than jobs. All applications for jobs go on file if they meet the qualifications and a job is not available. That way, if a job opens up, it can be filled quickly and efficiently.
Civilians, like the military, have their role to fulfill.
Marine gets mailorder bride
Strangers become engaged because of letters
Story by Sgt. T.G. Scully
CAMP HANSEN--Pfcs Cpl. Francis Garcia of MCB Camp S. D. Butler, wrote a letter to Rosa Linda Gonzales of West Covina, Calif. She accepted


Air-Dry
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On-Site
Desiccant Dry
FEDERAL BUREAU OF INVESTIGATION
July 28, 1978
Okinawa Marine
Gridiron refs to hold football officials clinic
Story by MSgt. Jim Mims
CAMP S.D. BUTLER--Three blind mice... striped zebra... bums, etc...are but a few descriptive phrases fun loving football fans unleash at the mediators of the sport each year.
Well, now is the time to pull out the old book of knowledge, sharpen up your wits, get the old vocal cords tuned up, because that time of the year is fast approaching.
In fact, the men in stripes have got the edge on their fans once again. Football officials throughout the world where the sport is played have already unpacked their garb, begun shining their chrome whistles and rehearsing their hand signals before the bedroom mirrors.
Within weeks the bold hearted grids who dash among towering bruisers like Gene Upshaw, Ted Hendricks, Mean Joe Greene and countless others will gather at their respective meeting places to begin another grueling pre-season scull session. For many officiating associations, like the Okinawa Athletic Officials Association (OAOA) here on Okinawa, pre-season classes for football officials will meet in the classroom two to three times a week for several weeks. Later as teams begin their scrimmage session, the OAOA officials will move outdoors and begin to rehearse their techniques.
Finally in the warming weeks of practice before "opening day," football officials will don their stripes for live scrimmages, knowing the old butterflies to strike with the fervor of nervous old coaches the old shot to ignore all the "Arm chair" experts. In addition, they will work on sharpening their keen sense of responsibility to insure absolute safety and fairness in one of America's leading sports.
Special official clinics are being conducted today at 7 p.m. at the Gimmon' Gym, Zukeran when Jerry Lyons, athletic director DECA and Jim Linebarger SCHOOA (Football official) will visit Okinawa.
So if you would like to get out where the action is, or feel you can do a better job than the man in stripes you harrassed all last year, put your money where your mouth is and contact Mr. Gary Gladek at 637-4428 (W) or 637-3833 (H) or any member of the OAOA and learn to be an official...you'll sadly be surprised to learn how much you really don't know about the game.
Marines host Schwab, Henoko Sports Day
Story by Cpl. Wayne Hollis
CAMP SCHWAB--Meeting in the sports arena, the spirit of friendship prevailing, Marines from Camp Schwab hosted the first of what is to become an annual event with the
Larry Kutchma scoring for the home team. It was the bottom of the third before the Okinawans scored again, this time twice, making the score nine to one in favor of the visiting people of Henoko.
between the Marines and Henoko Marines team. The Marines took, made up of women from the town of Henoko worked the Marines over in the best of three game series.
The Marines scored the first points, but


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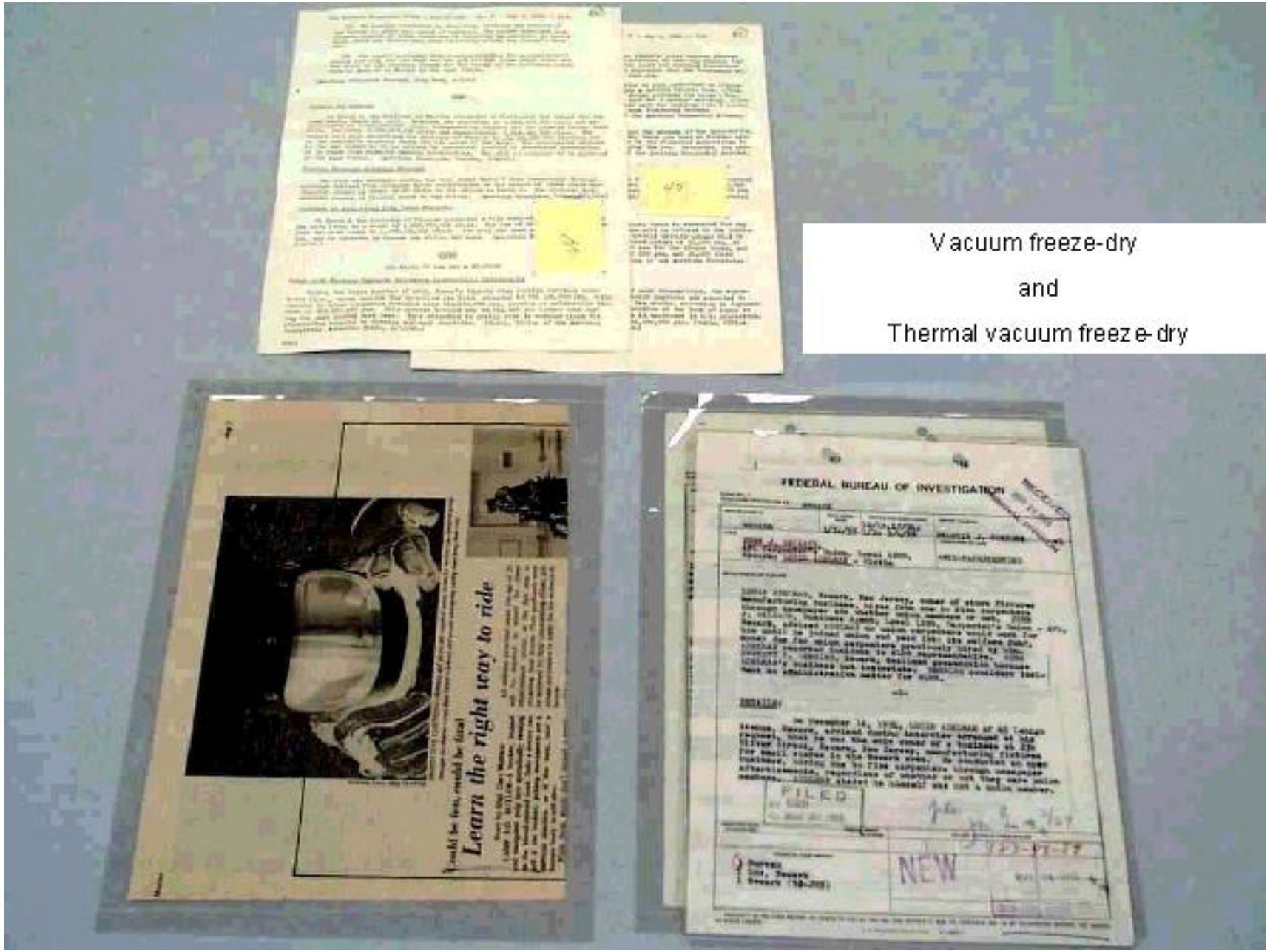
ports Day
Marines host Sc

Encapsulation


Off-Site
Desiccant Dry
NEW


Vacuum freeze-dry
and
Thermal vacuum freeze-dry
Learn the right way to ride
FEDERAL BUREAU OF INVESTIGATION
FILED
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or motorcycle operators going
must bring their own.

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Fasteners


On-Site
Desiccant Dry
Air-Dry
Off-Site
Desiccant Dry
Control
Vacuum
Freeze-Dry
Thermal vacuum
freeze-dry


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Conclusions

Lessons Learned

- items may receive additional treatment that you are not aware of
- original order may be disrupted
- intellectual control may not be preserved
- records may not be returned or become lost
- fees may be added without prior consultation or authorization
- one record storage box is often billed as 1.2 cubic ft.
- minimum fees can make a small drying project expensive
- specify how you would like groupings of records re-associated if their fasteners, folders, etc. cannot be preserved
- carefully consider method of delivery to the drying facility
- make sure you and your vendor are using the same technology terminology